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THE PLANT DISEASE BULLETIN

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THE PLANT DISEASE SURVEY

SUPPLEMENT 14

Diseases of Fruit Crops

in the United States in 1920

April 1, 1921

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UNITED STATES DEPARTMENT OF AGRICULTURE

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PLANT DISEASE SURVEY

1920

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DISEASES OF FRUIT CROPS IN THE UNITED STATES IN 1920

Prepared by
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CONTENTS

	Page		Page
Diseases of pome fruits	3	Cranberry	99
Apple	3	Diseases of cane fruits	99
Pear	62	Raspberry	100
Quince	68	Blackberry, dewberry, and loganberry	103
Diseases of stone fruits	69	Diseases of sub-tropical fruits	104
Peach	69	Citrus	104
Plum and prune	82	Banana	111
Cherry	86	Pineapple	112
Apricot	90	Fig	112
Diseases of small fruits	91	Diseases of nuts	113
Grape	91	Pecan	113
Strawberry	94	Walnut	113
Currant	98	Butternut	114
Gooseberry	98		

FOREWORD

The sources of information utilized in preparing the 1920 summary of fruit diseases were as follows:

1. Reports of state collaborators whose names appear on the opposite page. No reports on fruit diseases were received from Colorado, Florida, Louisiana, Maine, Montana, Nevada, Porto Rico, South Carolina, nor Utah.

2. Special reports of pathologists in the Bureau of Plant Industry and elsewhere. Among those who furnished valuable information may be mentioned C. L. Shear, Charles Brooks, D. F. Fisher, H. Atherton Lee, B. T. Galloway, and J. W. Roberts.

3. Reports of inspectors of the Bureau of Markets. The data secured from their certificates of inspection were arranged in a tabular form when possible.

4. Miscellaneous reports and records of the Plant Disease Survey. Articles from recent publications were used when these related to conditions in 1920.

Whenever possible the subject matter was treated under the following heads:

1. Geographic distribution and relative prevalence.
2. Nature of injury.
3. Dates of first appearance.
4. Relation of weather to prevalence.
5. Varietal susceptibility.
6. Control.

It was not possible to use this arrangement in all cases either because the heading did not apply to the disease under consideration or the information was not available from reports received.

General summaries of certain diseases were attempted in conformity with the plan of 1919. It is hoped that this plan may be followed more extensively in the future so that all the records which have accumulated in past years in the files of the Plant Disease Survey may be made available to workers throughout the country.

Crop production statistics were taken from the Monthly Crop Reporter Vol. 6, December 1920, of the Bureau of Crop Estimates. No attempt was made to give detailed losses in most instances since these will soon appear in tabular form as Plant Disease Bulletin Supplement 18. In those cases where losses were estimated, the basis for determining the loss was that followed in Supplement 12, i.e., the actual production is taken as 100% minus the sum of percentage of loss from all diseases of the crop in question.

Some alterations of the estimates submitted by the collaborators were deemed necessary in certain cases. Changes were avoided whenever possible but in some cases it was evident that differences between adjoining states, for example, were too great to be attributed to different environmental or cultural conditions. It was also evident in some few cases that collaborators made their estimates on the losses observed in neglected orchards or in a section of the state where the disease was most severe without taking the total crop into consideration. The effort has been to smooth out the inconsistencies as far as possible, with the least disturbance to the collaborators' figures. The figures in all cases are thought to be conservative.

It is hoped that in 1921 some more definite methods of estimating actual losses from some of our more common diseases may be suggested by the collaborators.

General Statement Concerning Reports on Weather Conditions by the Collaborators

The information from the collaborators concerning weather relations was rather meager in 1920. From our own experience in making out the reports in past years it is thought that this is largely due to the fact that by the time the collaborator summarizes his report in the winter he has only a vague recollection of the weather conditions during the growing season, or his observations on weather conditions have been quite local. The following suggestions may, therefore, be of value to those who wish to keep in touch with the weather conditions in their respective states.

The Weather Bureau issues two publications which can be obtained by the collaborators and which will give them detailed data on weather conditions. These are:

1. Climatological data. This is a monthly summary of weather conditions in each state, with the exception of some of the New England States which are grouped, and Delaware and Maryland, which have a single report. Daily temperature and precipitation records from a large number of stations in each state

are given. These may be obtained from the weather bureau headquarters of the respective states, and usually appear within two or three weeks after the month for which the records are made.

2. National weather and crop and snow and ice bulletin. This gives a weekly summary of weather conditions throughout the country and is especially valuable on account of the maps which give the precipitation and temperature records for the week for the entire country. Telegraphic reports from each state weather station are included, thus presenting a weekly summary of the weather conditions by states. This may be obtained by writing to the Weather Bureau at Washington.

It takes only a few minutes to look over these weather reports when making out the disease summaries and exact and complete information is there presented for all portions of the state and country.

DISEASES OF POME FRUITS

APPLE

Scab caused by Venturia inaequalis (Cke.) Wint.

As usual scab was generally prevalent throughout the apple growing region of the United States. As compared with former years, it was more serious than the average year but probably caused less general damage than in 1919. In the New England States scab was slightly more serious, while in New York and Pennsylvania it was less severe than in 1919. Along the Coastal Plain of the South Atlantic States very little loss occurred, while in the Appalachian region south of Pennsylvania the loss was even more severe than in 1919 when it was much worse than the average. Dry weather following the blooming period was unfavorable for scab development in the Great Lakes region, especially in New York, Michigan and Wisconsin, but a wet summer favored a late infection in some of these states. An unusually cold, wet early spring in the Ohio and Upper Mississippi Valleys resulted in a heavy initial infection, especially in Ohio, Indiana and Illinois. This, combined with other factors, caused a heavy dropping of blossoms and young fruit. In the Gulf States the damage from scab was about average, while in the North Central States west of the Mississippi River the loss was somewhat greater than in 1919.

The estimated percentage loss from scab in 1920 was 5.6% as compared with 3.9% in 1919. The loss to the total crop was about 16,259,000 bushels in 1920 as compared with 6,544,000 bushels in 1919.

The loss in the Northwest was not very great, owing to the fact that little scab was present in the commercial apple section of Washington, but the losses in western Oregon, especially in the Willamette Valley, were heavy for that section.

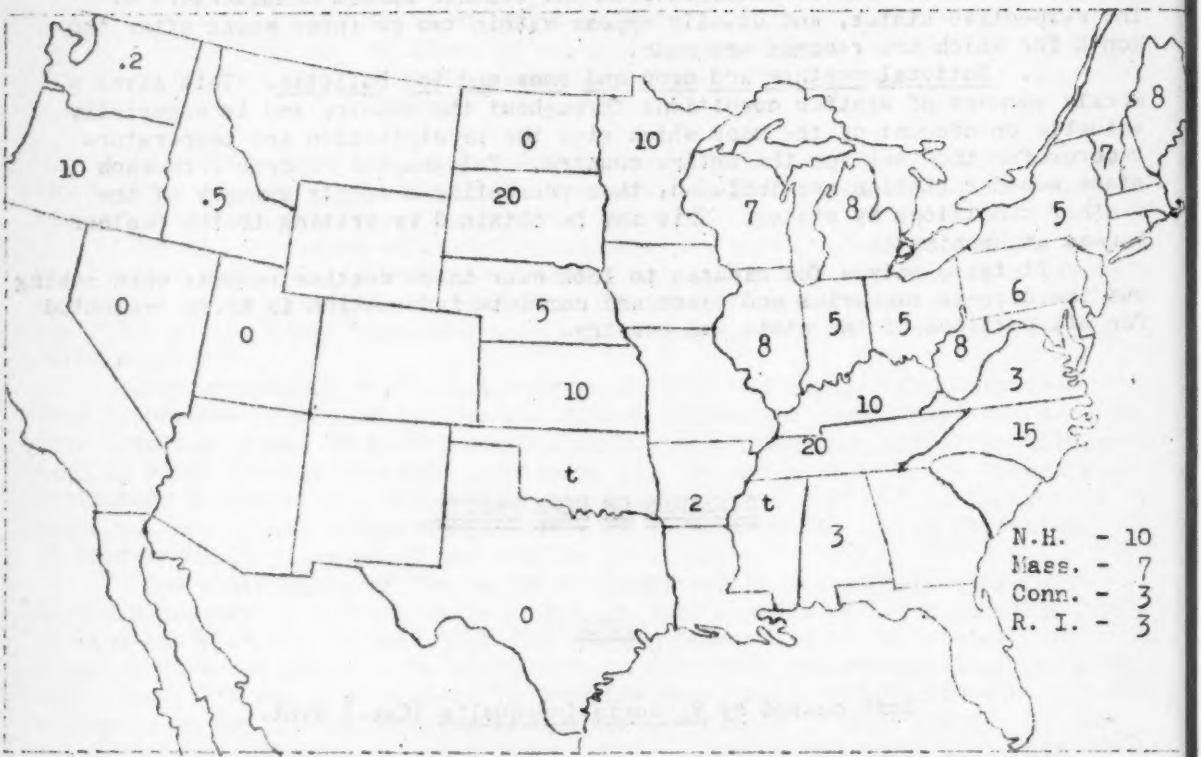

Fig. 1. Estimated percentage loss from scab in the United States 1920.

Table 1. Losses from scab caused by Venturia inaequalis during calendar year 1920, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of scab: No. cars	Percentage of scab: Percent	Remarks as to seriousness of scab	Origin of shipment	Percentage of scab: No. cars	Percentage of scab: Percent	Remarks as to seriousness of scab
Canada	2	5-15	Quite serious in 1 car	Oregon	5	3-38	Some badly scabbed apples
Ill.	1	12	Associated with blotch	Pa.	4	5-18	
Maine	1	30		Unknown	4	8-23	Estimates include other blemishes
Md.	1	20		Va.	8	5-17	
Mass.	1	18	Associated with other blemishes	Wash.	2	18-20	
Mich.	3	6-15		W. Va.	1	45	Velvety scab (Sooty fungus ?
N. Y.	27	3-32	Estimates include other blemishes	N. Y.			
Total		60		Total number of cars inspected			3384*

*Approximate

Prevalence of scab is reported as follows by the collaborators from the North Atlantic States: Vermont (Lutman)- Some infection locally on all susceptible varieties; probably a little more than normal. New Hampshire (Butler)- Worse than average, causing considerable damage to susceptible varieties. Massachusetts (Osmun)- Very abundant throughout the state on susceptible varieties; worse than last year and worse than average. Connecticut (Clinton)- A little worse than last year and more than average. New York (Chupp)- Not as severe as last year and less than average; more important later in the season. Most injury in the Lake Ontario region. New Jersey (Cook)- Widely distributed but in most cases not severe; less than last year. Pennsylvania (Thurston)- Less than last year; most important on commercial orchards in the South.

Collaborators from the South Atlantic States report as follows on the relative prevalence of scab: Delaware (Mann)- Quite severe on susceptible varieties (July). Maryland reported more than usual; "Scab has been on the increase for two years". Virginia (Fromme)- The commercial crop as a whole is very much better than last year; scab is very severe, however, in home orchards and those which did not receive proper spraying; less than last year but more than the average. West Virginia (Giddings)- More than last year and much worse than average. North Carolina (Jehle)- More than last year; prevalent and severe at elevations above 2000 feet.

In the South Central States the disease was severe in the Appalachian regions of Kentucky and Tennessee, extending into northern Alabama. Tennessee (Essary)- Unusually abundant this year. (Hesler)- Scab worse than average. Pedicel infection of the fruit has been heavy this year. Alabama (Thiel)- Present throughout the state; losses from 2-5% in the northern part. Texas (Taubenhaus)- No scab in state. Arkansas (Elliott)- Severe on unsprayed fruit; less severe than average. (L. Pierce)- Practically no scab on fruit in well sprayed orchards of Benton and Washington Counties.

In the North Central States east of the Mississippi scab was especially serious owing to an unusually cold, wet spring during the cluster bud stage. Later a dry period in the northern tier of states checked the disease to some extent. Ohio (Selby)- Has been very general and severe on both fruit and foliage; probably most severe epidemic since 1916. Indiana (Gardner)- Worse than last year in south half of state; very light in northeast corner of the state where it is usually most severe. Illinois (Anderson)- Worse than last year and more than average. Especially bad in central and western part of state. Heavy drop of blossoms and small fruit due to early infection. Michigan (Coons)- Less scab than usual, to be accounted for by drought for one month following blossoming time (July 1). Epidemic in northern half of Lower Peninsula. No first class apples in ordinary, poorly cared for orchards of northern counties; southern counties excellent, sprayed or not (final report). Iowa (Melhus)- Less than in 1919. Wisconsin (Vaughan)- Less than last year and less than average. Hot, dry weather while leaves were forming and fruit setting. Minnesota reported more scab than usual, especially important in the southern half of the state.

The collaborators from the North Central States west of the Mississippi River report as follows: Minnesota (Leach)- Severe local epidemics are common; some orchards are very heavily infected. North Dakota (Lolley)- Not observed in the state. South Dakota (Michel)- Quite common; especially good year for development of scab. Nebraska (Goss)- Present in the usual amount, not serious. Kansas (Melchers)- Common in all unsprayed orchards; will cause 10% damage.

Few reports have been received from the collaborators in the Northwest. Such as have been received indicate a light loss to the commercial crop. Idaho (Hungerford)- More than last year; in north Idaho only. Washington (Heald and

Dana)- Slight reduction since scab is absent from the commercial apple sections of the state. Oregon (Barss)- Much worse than last year; serious in western Oregon, especially in the Willamette Valley, where many young orchards are just coming into bearing and where the growers have not yet learned the habit of timely and thorough spraying. In many of the commercial orchards 50% of the crop will be culls. California (Smith)- Slightly under normal.

The following additional reports have been received: Nevada (Lantz)- Not known to be present in the state. Oklahoma (Learn)- Just one report so far this year (July 1). Mississippi (Neal)- One report from Pontotoc County. Georgia (McClintock)- None observed to date (July 7). Manitoba (Risty)- A small amount of scab occurred on leaves and fruit of apples at Winnipeg. Spraying has not been practiced and scab was not serious enough to warrant it.

Relation of Weather Conditions to Scab Infection.

A systematic attempt to correlate weather conditions with the amount of scab throughout the country would be of great value to those interested in the disease. Unfortunately, the reports from the collaborators were not complete enough in this particular to form a basis for summarizing. The climatological data for the important apple-growing states as furnished by the Weather Bureau were carefully examined with the hope that these, in conjunction with those furnished by the state collaborators, would furnish the desired information. Some difficulty was experienced on account of the fact that scab infection may take place over a comparatively long period, and the exact dates of probable infection were not given by many collaborators.

The month of April, during which the ascospores usually begin to shoot, was unusually wet throughout the entire country, but it was also a very cold month so that the development of the host was considerably delayed. The weather was favorable for scab so far as precipitation was concerned but it is probable that in the majority of states no infection took place at this early date on account of the delayed development of the host.

In May there was considerable variation in the different sections of the country. In New England cold weather continued and the conditions for April prevailed for the first half of the month. It was generally wet and conditions for scab infection were good toward the latter part of the month. This accounts for the rather severe scab conditions in Maine, New Hampshire, Vermont and parts of Massachusetts. Across the northern section of the country, including New York, Pennsylvania, Michigan, Wisconsin, Iowa, northern Ohio, Indiana and Illinois there were drought conditions during the greater part of May. This prevented a severe primary infection in this region and such scab as developed appeared later in the season. This same condition prevailed in the Atlantic Coast States, especially in Maryland, New Jersey, Virginia and North Carolina. The month was also quite cool in all these states. These conditions were unfavorable for scab except in local areas where there were sufficient cloudy days to allow the disease to become established. In West Virginia the rainfalls were so distributed as to give better conditions for infection. The rainy periods were about a week apart throughout the month.

Over the Southern States and extending as far north as central Ohio, Indiana and Illinois, the precipitation was heavy throughout the greater part of May and the weather as a whole was cool, thus presenting ideal conditions for the development of scab. Scab showed up rather late in the North Central States, due to the very cold weather, but was very severe when it finally appeared. In Arkansas and Missouri especially favorable conditions for scab prevailed in May. In both states precipitation was very heavy and the weather was cool and cloudy.

The conditions which brought about late infection in certain states are given in the reports of the collaborators which follow.

Weather Conditions as Reported by the Collaborators.

Vermont (Lutman) July 15 - Around Burlington much worse than last year; rainy weather in early May and late June seems to be the cause.

Massachusetts (Osmun) July 15 - Weather conditions have favored the development of the fungus. (Krout)- Weather conditions have been favorable for scab.

New York (Chupp) July 1 - Relatively, however, the disease is unusually rare, due to abnormally dry weather. Final report - Dry in spring with late summer rains.

Virginia (Fromme)- Wet May and June, moderate to cool.

Tennessee (Hesler)- Wet season, continuous rains May 15 to June 20 and again in August. Cool spring. All favored the development of scab.

Arkansas (Elliott)- Weather unfavorable for the disease. (See report on conditions in Arkansas during May.)

Ohio (Selby)- The prevailing excessive humidity and subnormal temperature during the season of 1920 has led to the fullest growth of the fungus.

Illinois (Anderson)- Cold, wet weather during the cluster bud stage in central and western Illinois favored the development of scab, and prevented the growers from making their spray applications at the proper time. The remainder of the season was not especially favorable for scab.

Michigan (Coons) July 1 - Less scab than usual, to be accounted for by one month of drought following blossoming time.

Wisconsin (Vaughan)- We had a number of days of hot, dry weather while the leaves were forming and fruit setting, resulting in less scab than usual. (Keitt)- An additional early treatment on May 24 was of little value, due to the unusually long dry period that followed (Sturgeon Bay observations).

Oregon (Barss)- Unusually abundant; spring rains into June favored scab in all of western Oregon except in extreme south.

Discharge of Ascospores.

Three states report on the actual time of ascospore discharge in the spring. This information is of great value in determining the time when infection may be expected during the average season. Collected over a number of years it will determine whether or not there is a correlation between first ascospore discharge

and the developmental stage of the host.

Wisconsin (G. W. Keitt from abstract in Phytopath. Jan. 1921)- At Madison the first discharge was noted on April 23 and the last on June 12. The heaviest discharge occurred between May 11 and May 24. The apple buds separated in the cluster about May 17 to May 19. Developments were probably considerably influenced by a dry period from May 1 to 9. At Sturgeon Bay the first discharge was noted on May 20 and the last on June 30. The heaviest discharges occurred between June 8 and June 17. The apple buds separated in the clusters about May 29-30. Developments were probably considerably influenced by a long dry period in early May and another from May 24 to June 6.

New York (Chupp)- According to observations of the field men, infection occurred on April 27-29, May 10-11, June 17-19. There were no long rainy periods.

Illinois (Anderson) - Discharge of ascospores was noticed on April 20 but infection on the leaves did not show up until May 14. The long period of incubation was probably due to the unusually cold weather which prevailed the latter part of April and the first week in May, during which time the temperature was always below 65°F. and was usually below 60°. Discharge was especially vigorous during the middle of May when heavy rains occurred. This resulted in a serious fruit infection in many orchards.

Table 2. Dates of earliest appearance of scab according to collaborators.

State	Date first noticed		Locality	
	1919	1920	1919	1920
Maine (Stevenson)	--	June 11	--	Corrina
New Hampshire	June 8	July 15	--	Gonic
Vermont	July 1	--	--	--
Massachusetts	--	May 20	--	Amherst
Connecticut	--	June 25	--	Melford
New York	April 21	June 7	--	Orleans County
Pennsylvania	June 12	May 14	Adams County	York County
Virginia	June 3	May 21	Staunton	Blacksburg
Tennessee	June 1	May 10	--	Cleveland
South Carolina	July 1	--	--	--
Georgia	June 1	--	--	--
Oklahoma	June 5	--	--	--
Arkansas	May	--	--	--
Ohio	June 7	June 2	--	Athens County
Indiana	May 24	May 28	--	Morgan County
Illinois	May 1	May 14	--	Savoy
Wisconsin	June	May 25	--	Madison
Minnesota	May 28	June 20	--	Lake City
Missouri	July 7	--	--	--
South Dakota	May 26	--	--	--
Kansas	May 20	--	--	--
Washington	May 19	--	--	--

Varietal Susceptibility.

The lists of susceptible and resistant varieties appearing in the reports of the Plant Disease Bulletin in past years, as well as in the current numbers, show considerable discrepancy. This is also true of lists published by the workers in the state experiment stations. These discrepancies are not necessarily the result of faulty observation, but may be due to one or more of the following causes:

1. The varieties compared in a given locality. For example; if Stayman Winesap and Winesap occur in the same orchard, the Winesap is so much more susceptible than Stayman that one is inclined to list Stayman as very resistant. Fromme, in Virginia, shows that in his check blocks in a spraying experiment, where these two varieties were used, Stayman had 18% of scabbed fruit while Winesap had 66%. On the other hand, if York Imperial or Grimes were grown by the side of Stayman, the latter would probably show much more scab than the other varieties and would thus be listed as susceptible.

2. The time of infection. Yellow Transparent is often listed as resistant but this variety scabs very badly during some seasons. This is true of several of the early varieties.

3. The severity of infection. During some seasons and in some localities only the very susceptible varieties scab, thus giving the impression that the less susceptible varieties are relatively resistant.

4. It is possible that geographic location may have some influence but it is probable that this has much less influence than the factors given above.

Lists assembled over a number of years, together with notes on the climatic conditions and the relative amount of scab during the season will be of great value in the final estimate of the relative susceptibility of varieties. For this reason collaborators from all the states are urged to continue to send in reports on observations made each year. Observations made in a single orchard of a number of varieties would be of special value.

Table 3. Susceptibility of varieties by states, 1920.

	Susceptible				
N. H.	McIntosh	Wis.	Fameuse	Tenn.	Champion
	R. I. Greening		McMahon		Paragon
	Gravenstein		Wealthy		Kinnard
	Crab		McIntosh		
	Baldwin (slightly)			Ind.	Moyer
		Md.	Rome Beauty		Salome
Mass.	McIntosh		Ben Davis		Ben Davis
			Winesap Family		Winesap
Conn.	McIntosh				Rome Beauty
	Fall Pippin	Va.	Winesap		Delicious
			Black Twig		Fameuse (snow)
N. Y.	R. I. Greening		Delicious		
	McIntosh		Jonathan	Ill.	Rome Beauty
			Virginia Beauty		Kinnard
Pa.	Transparent		King David		Cornell
	Greening		Ben Davis		Fameuse
	Ben Davis				Sherwoods Favorite
	Rowe	Tenn.	Early Harvest		Early Harvest
	Grimes		Early Ripe		Huntsman
	Smokehouse		Delicious		

Susceptible (Cont.)

Pa.	Stayman	Tenn.	Jonathan	Ill.	McIntosh
	Baldwin		Yates		Red June
			Red Rees		Ben Davis
Wis.	Lubsk Reinnette		Senator		

Resistant

Va.	York	Ind.	Stark	Ill.	Jonathan
	Grimes		Flora Bell		Yellow Transparent
	Stayman		Bellflower		York
			Stayman		Duchess
Tenn.	Yellow Transparent		York		
	Winesap		Black Twig	Wis.	Jonathan
	Red June		Jonathan		Winesap
	Grimes		Grimes		Tolman Sweet
	York				Windsor
		Ill.	Stayman		
Ind.	Yellow Transparent		Grimes	Md.	York
					Grimes

Table 4. List of susceptible and resistant varieties as reported in 1920.

Susceptible

Baldwin - slightly, N.H. Pa.	Grimes - Pa.	Rome Beauty - Ind. Ill
Ben Davis - Pa. Va. Ind. Ill.	Jonathan - Va. Tenn.	Rowe - Pa.
Black Twig - Va.	King David - Va.	Salome - Ind.
Champion - Tenn.	Kinnard's Choice - Tenn. Ill.	Senator - Tenn.
Delicious - Va. Tenn. Ind.	McIntosh - N.H. Mass. Conn.	Smokehouse - Pa.
Early Harvest - Tenn. Ill.	Wisc. N.Y. Ill.	Stayman - Pa.
Early Ripe - Tenn.	Moyer - Ind.	Transparent - Pa.
Fall Pippin - Conn.	Paragon - Tenn.	Virginia Beauty - Va.
Fameuse - Ind. Ill. Wisc.	Red Rees - Tenn.	Winesap - Va. Ind.
Gravenstein - N.H.	R.I. Greening - N.H. N.Y. Pa.	Yates - Tenn.

Resistant

Black Twig - Ind.	Stayman - Va. Ind. Ill.
Duchess - Ill.	Stark - Ind.
Early Harvest - Ind.	Tolman Sweet - Wis.
Flora Bell - Ind.	Windsor - Wis.
Grimes - Ill. Va. Tenn.	Winesap - Tenn. Wis.
Jonathan - Ind. Ill. Wis.	Yellow Transparent - Tenn. Ind. Ill.
Red June - Tenn.	York Imperial - Va. Tenn. Ind. Ill.

Control Measures for Apple Scab.

Connecticut (Clinton)- In all cases controlled by spraying.

New York (Chupp)- The delayed dormant has been proved as one of the important scab sprays. Five applications were necessary for clean fruit.

New Jersey (Haskell)- Mr. Repp, one of the largest growers in New Jersey, is using self-boiled lime sulfur as a summer spray. The calyx spray is commercial lime sulfur, but the later ones are self-toiled. It costs a little more but does the work, does not injure fruit or foliage and shows up better on the trees so that one can tell just where the spray has been applied.

Virginia (Fromme)- Good, thorough spraying has held scab in most cases. Dry lime sulfur and commercial lime sulfur sprays gave equally good control, averaging about 95% clean fruit, while the checks showed 66% scabby fruit.

West Virginia (Giddings)- Good control with lime sulfur and Bordeaux.

Tennessee (Hesler)- In most commercial orchards spraying has evidently been done too late, especially the "pink" application, which in many cases was omitted entirely.

North Carolina (Elliott)- Almost complete control by petal-fall spray. Lime sulfur used.

Ohio (Selby)- Good fruit conditions are generally reported where a pre-bloom spray of Bordeaux mixture was applied; favorable report is made in one or more cases from pre-blossom spray of lime sulfur. The early or pre-pink application of Bordeaux gave excellent results in Gallia County. In many cases north of the central region the delayed dormant spray, successful in 1919, made a failure in scab control for 1920.

Indiana (Gardner)- Lime sulfur spray gave good control. Dust poor in badly affected regions.

Illinois (Anderson)- Orchards well sprayed with lime sulfur were fairly clean. Very poor control with dust. Considerable scab developed where the pre-bloom spray was not applied. On account of the extremely wet conditions prevailing when this spray was due, thus preventing or delaying spraying, considerable loss resulted in many commercial orchards. In one orchard 90% of the crop was lost because of failure to spray at this period. Considerable foliage injury resulted from applying sprays after the leaves had become scabbed.

Michigan (Coons and Nelson)- Dusting not successful in northern epidemic area.

Wisconsin (Vaughan)- Small loss in well sprayed orchards. Pink spray most important.

Oregon (Barss)- Sprays carefully applied were very successful even this year, but large acreages in Willamette Valley coming into bearing not given skillful care.

The following report covering the cooperative dusting experiments of the Advisory Board of the American Phytopathological Society was received from Dr. N. J. Giddings, project leader:

"Dusting and Spraying for Control of Orchard Diseases and Insects - Committee Report.

"At the St. Louis meeting of the American Phytopathological Society, this project was selected by the Advisory Board as one which should receive special attention, and a leader was appointed to secure all possible cooperation among the various interested pathologists.

"A conference was called at Washington, D. C., on March 11, 1920, in order to discuss the work and draw up plans which might be of value to all. As a result of this conference some suggestive outlines for work with peaches and apples were sent to pathologists and entomologists who were thought to be interested in such work.

"This outline was sent to men in twenty-six states and replies from twenty-three of these states indicated interest in the project, while eighteen were quite favorable toward the work. Experiments were actually conducted in at least nine states, including Indiana, Michigan, New Jersey, New York, Connecticut, Pennsylvania, Maryland, West Virginia and Virginia. Seven of the cooperating states have already submitted data giving results for the 1920 season, and reports are expected from the others.

"From the states reporting definite figures for 1920, there was good control of scab in five orchards and extremely poor control of apple scab in five orchards, while Nova Scotia reported comparatively poor scab control from the use of sulphur dust but good control with copper lime dust. There are reports from other orchards and other states in which the amount of scab was 10% or less and the results were conceded by all concerned as unreliable in such cases. Michigan reported good control with dust in one orchard; Virginia reported good control with dust in two orchards; Pennsylvania reported good control with dust in two orchards; Pennsylvania reported poor control with dust in one orchard; Connecticut reported poor control with dust in two orchards; and West Virginia reported poor control with dust in two orchards. Indiana reported that as a result of three years' work they are not ready to recommend dusting since the liquid has proven somewhat more efficient and dusting has been found somewhat more expensive.

"Copper lime dust was tried in West Virginia and Virginia but with very unsatisfactory results.

"A number of new dust mixtures were tested in West Virginia and of these the one which seemed most desirable in all respects was sulphur-lime sulphur-arsenate in the proportions 75-15-10. This dust will doubtless be tested out more extensively in West Virginia during the coming season and it is hoped that similar dust combinations may be tried in some other states.

"Because of the large number interested in this problem it is hoped that experimental work may be conducted in a larger number of states during the season of 1921.

(Signed) N. J. Giddings
Project Leader"

Blotch caused by Phyllosticta solitaria E. & E.

Apple blotch has not been reported from any additional states during the past year. It is still confined to the region south of the 42nd parallel and east of the 100th Meridian, as pointed out in Plant Disease Bulletin Supplement 9. However, the disease is evidently becoming more generally prevalent on the outskirts of the heavily infested area. It is more generally distributed along the eastern edge in Virginia and New Jersey and along the northern edge in Pennsylvania, Ohio, Indiana, Illinois and Iowa, than formerly.

In a former number of the Plant Disease Bulletin (Suppl. 9: 96-98 1920) there was presented a summary of the facts concerning the spread of this disease northward. Since the appearance of this summary a special survey was made in northern Illinois to determine the extent of the northward invasion. Several new records were obtained and it was shown that the disease was well established in isolated orchards well to the north of where it had been previously observed. In practically every case it was found to have established itself on one susceptible variety, Northwestern Greening, and where blotch was found on any other variety the initial infection in the orchard could always be traced to Northwestern Greening.

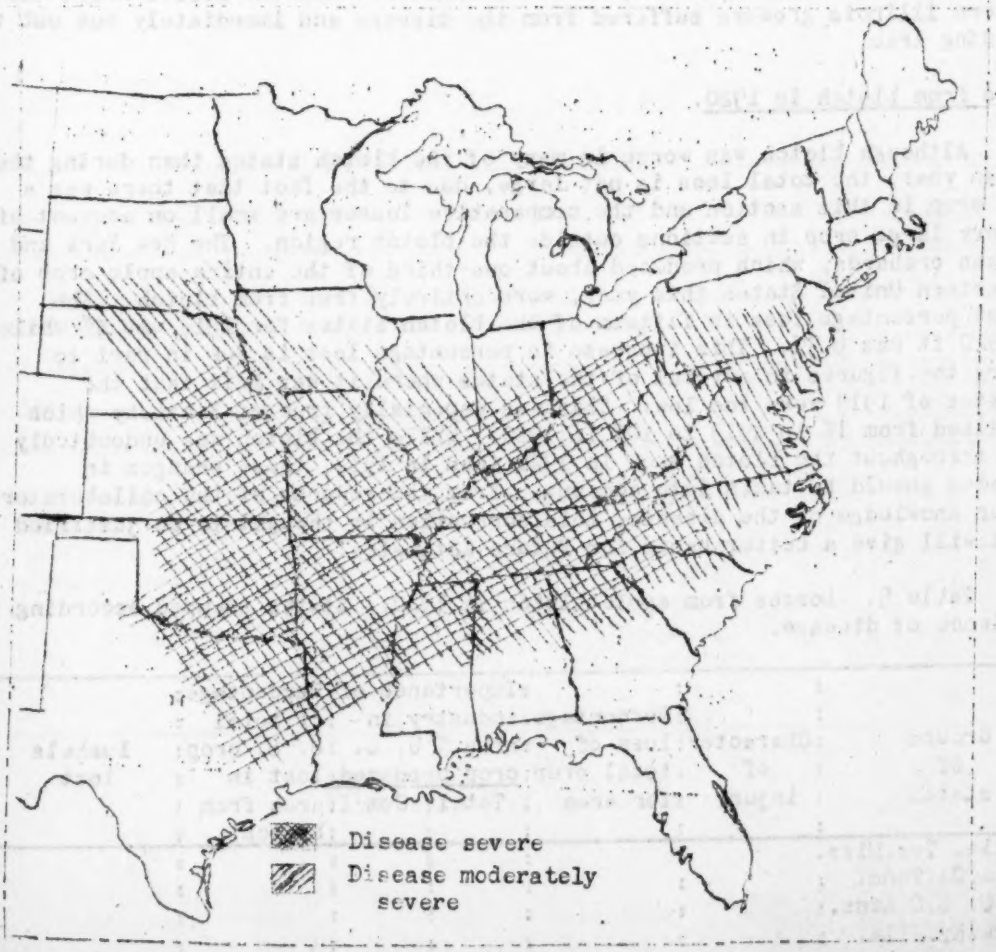

Fig. 2. Occurrence of apple blotch in the United States,- revised to 1920.

The fact that certain very susceptible varieties are serving as blotch "carriers" has given rise to the question as to whether or not it would be practicable to prevent the further advance of the disease in the border sections by paying particular attention to the "carriers". Growers should be warned against the varieties and the planting of these should be discouraged. Wherever they are found the orchardist should be warned to expect the appearance of blotch on this variety, or, if it is established, he should be instructed as to the best method of keeping the disease in check. Two examples in this connection may be given from Illinois; in one orchard a row of Missouri Pippins were growing along the edge of a large Ben Davis and Maiden Blush orchard. The Pippins were thoroughly covered with blotch and the fruit was worthless. Only a few of the Bens were blotched and the disease had not yet reached the Maiden Blush which were on the other side of the Bens. The orchard was not in a blotch section and the grower was not familiar with the disease. He explained that he had rarely harvested the Missouri Pippins because there was little market for them and so few of them. When his attention was called to the blotch and the danger explained, he had the entire row of trees cut down within forty-eight hours. In another case a single badly blotched Northwestern Greening was found in an orchard north of the blotch area. The owner was not familiar with blotch although he had seen the "black spots" on the fruit of the Northwestern Greenings. He was, however, familiar with the losses which the southern Illinois growers suffered from the disease and immediately cut out the offending tree.

Losses from blotch in 1920.

Although blotch was worse in many of the blotch states than during the average year, the total loss is not large, due to the fact that there was a light crop in this section and the comparative losses are small on account of the very large crop in sections outside the blotch region. The New York and Michigan orchards, which produced about one-third of the entire apple crop of the eastern United States this year, were entirely free from blotch. The average percentage loss in fifteen of the blotch states for 1919 was 4% while for 1920 it was 6.3%. This increase in percentage loss is due in part to raising the figures in several of the states where it was felt that the estimates of 1919 were too low. This was especially true of Kentucky which was raised from 1% in 1919 to 10% in 1920. While the blotch was undoubtedly worse throughout the blotch area in 1920 than in 1919, these changes in estimates should be taken into account. From the reports of the collaborators and our knowledge of the disease, this correction is thought to be justified and it will give a better basis for future estimates.

Table 5. Losses from apple blotch in 1920. States grouped according to prevalence of disease.

Groups of states	Character of injury	Percentage loss of total crop for area	Importance of industry in area.% U. S. crop produced: Total	Com'l	Percentage of total U. S. crop lost in area from blotch	Bushels lost
A.- Okla. Tex.Miss. Ala.Ga.Tenn. N.C. S.C.Kans. Ark.Ky. (La. crop unimportant)	Severe	5% to 10%	12.1	5.7	1.4	4,032,500

Groups of states	Character of injury	Percentage loss of total crop for area	Importance of industry in area % U. S. crop produced. Total	Com'l	Percentage of total U. S. crop lost in area from blotch	Bushels lost
B.- Ill. Nebr. Mo.	Moderate	3% to 4%	5.	7.2	0.2	579,000
C.- Pa. O. Ind. W. Va.	Slight	1%	20.9	14.6	0.3	825,000
D.- N.J. Del. Md. Va. Ia.	Trace	Less than 1%	11.7	13.5	Trace	--
E.- 20 remaining apple-producing states	None	0	50.3	59.	0	0
Loss to total U. S. apple crop from blotch in 1920					1.8	5,194,000

Table 6. Percentage of blotch as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of blotch: No. cars	Percent	Origin of shipment	Percentage of blotch: No. cars	Percent
April 17 - May 19, 1920:			July 6 - Dec. 10, 1920:		
Illinois	1	50	Arkansas	1	10
Unknown origin	1	23	Illinois	3	8-22
Total	2		Missouri	1	2
			Tennessee	2	35-57
			Virginia	5	5-33
			Total	12	
			Grand total	14	
			Total number of cars inspected	3384 (Approx.)	

Dates when first observed:

Arkansas	- May	Virginia	- June 23
Indiana	- May 28, Morgan County	Missouri	- July 1, Higginsville
Illinois	- May 28, Anna	Pennsylvania	- July 17, Lackawanna County
Tennessee	- June 12, Knoxville		

Varietal Resistance.

It may be said that apples show a sharper varietal resistance to blotch than to any other disease with the possible exception of cedar rust. While no varieties are known to be immune, many are so resistant as to be classed as immune from a commercial standpoint. Apparent resistance of certain varieties is often due to limited observations, since during some seasons varieties which are susceptible may escape infection.

The following reports on susceptible and resistant varieties have been received from the collaborators this year:

Susceptible	
"All Sweet Apples" - Pa.	R. I. Greening - Ind.
Arkansas Red - Ind.	Rome Beauty - Ill.
Ben Davis - Pa. Ill. Va. Tenn. Ohio Ind. Ia.	Smith Cider - N.J. Pa. Ill. O. Ind.
Benoni - Ill.	Stark - Ind. Ill.
Black Ben - Tenn.	Yellow Transparent - Ark.
Delicious - Tenn.	
Duchess - Tenn. Ind. Ill.	Resistant
Early Harvest - Tenn.	
Huntsman - Ill.	Grimes - Tenn. Ill. Ind.
Limbertwig - Va. Tenn. Ark. Ill.	Ingram - Tenn.
Maiden Blush - Pa. Ill. Tenn.	Jonathan - Tenn. Ill. Ind.
Mann - Ohio & Ind.	Red June - Tenn.
Missouri Pippin - Ind. Ill.	Stayman Winesap - Ill.
North Western Greening - W.Va. Ill. Ind. Ia. Md.	Winesap - Tenn. Ill.
Paragon - Tenn.	York - Tenn. Ill.
Red Astrachan - Ark.	

Blotch Control.

Blotch is considered one of the hardest diseases to control where it has once become thoroughly established. This is largely due, no doubt, to the fact that the cankers in which the fungus winters become so numerous as to supply an unlimited amount of inoculum. Little attention is paid these cankers by the growers and no attempt is made to control the disease until the trees come into bearing and the results of infection show in the fruit. The time of infection in different localities and on different varieties has not been accurately worked out so that the proper time for the applications of the blotch spray is not as accurately known as in the case of scab. During the last three years the tendency has been to apply the first blotch spray within two weeks or eighteen days after the petals fall instead of three weeks, as was formerly the practice. This has resulted in better control on early varieties in the southern part of the blotch region. More information is needed on the time of infection in the various blotch states and the relative value of Bordeaux and lime sulfur. The collaborators report as follows on blotch control:

Alabama (Thiel)- Where spraying was carried on, the disease was checked but not controlled entirely.

Mississippi (Neal) Not serious in well sprayed orchards.

Arkansas (Elliott)- Very severe on fruit not properly sprayed. Good results with Bordeaux.

Ohio (Selby)- Bordeaux mixture, 4-5 applications gave good results.

Indiana (Gardner)- Good control with Bordeaux spray, 2-4-6-10 weeks and lime sulfur 2-4-6-10 weeks.

Illinois (Anderson)- Where orchards were well sprayed with either lime sulfur or Bordeaux early in the season (2 weeks), the fruit was in fair condition. Failure to apply blotch spray early (within 3 weeks) results in poor control. In general, blotch was not controlled satisfactorily even in the best sprayed orchards. This was due in part to very heavy rains following the two weeks spray where this was applied and consequent washing off of spray material. It was at this time that the first infection occurred.

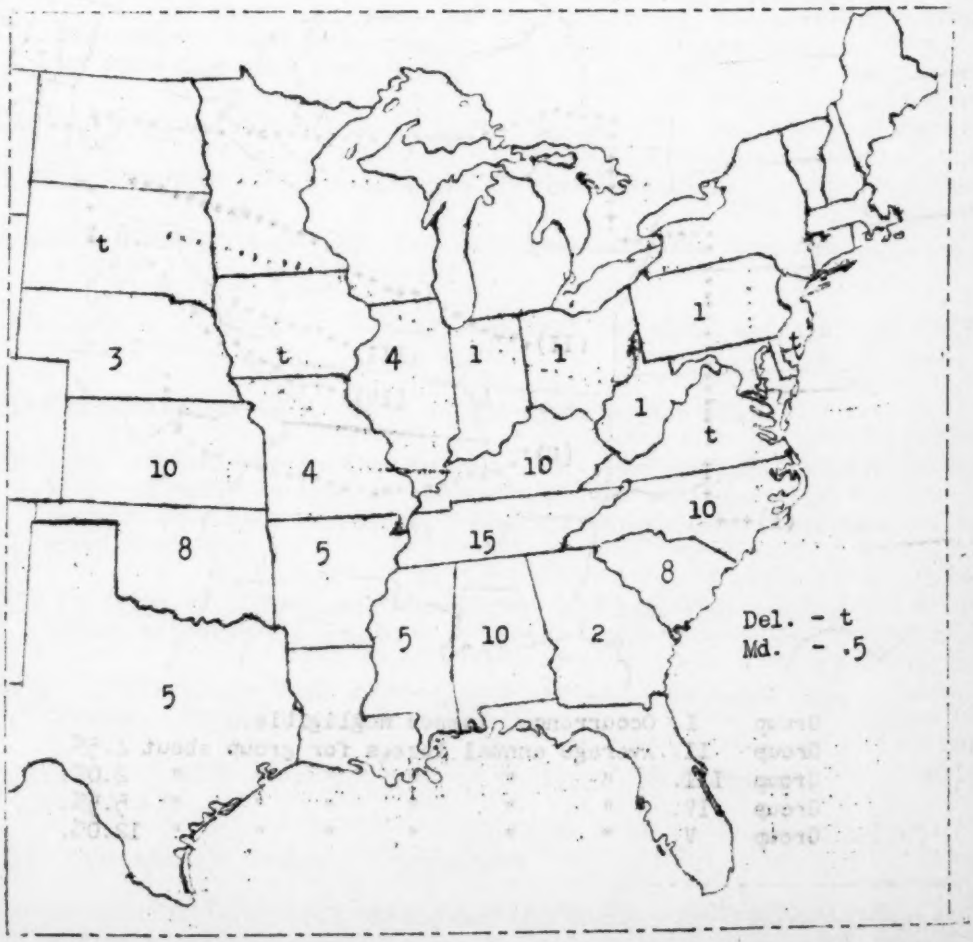

Fig 3. Estimated percentage loss from blotch, 1920.

Bitter rot caused by Glomerella cingulata (Stonem) S. & S.

As in 1919 heavy loss from bitter rot was confined to only a few of the bitter rot states. The disease was as a whole less destructive in 1920 than in the previous year. New Jersey, Tennessee, and Ohio were the only states reporting the disease worse than last year, and in the last state the loss was negligible, according to Selby. Virginia and North Carolina, where epiphytotics of bitter rot occurred last year, escaped with only mild outbreaks this season. Following the group system of last year (see Fig. 4), the states of group I suffered practically no loss, most of the states not reporting the occurrence of the disease. New Jersey, however, reports more loss than usual.

In group II, including Missouri, Illinois, Indiana, Ohio and Pennsylvania, the three middle states suffered a negligible loss while the disease seems to have been of about the average importance in Pennsylvania and quite

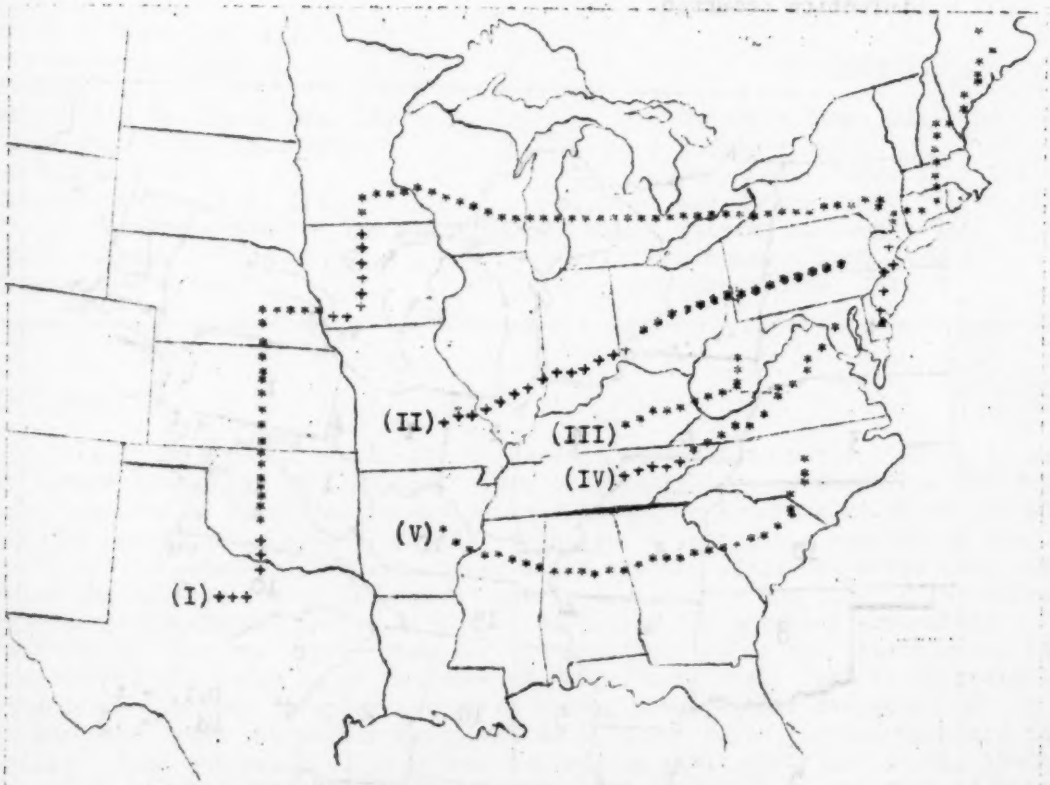
(I)
(II)
(III)
(IV)
(V)
Group I. Occurrence, losses negligible.
Group II. Average annual losses for group about 4.5%.
Group III. " " " " " " 2.0%.
Group IV. " " " " " " 5.5%.
Group V. " " " " " " 12.0%.

Fig. 4. States grouped according to average percentage losses from bitter rot.

severe in parts of Missouri. In group III, including Kentucky and West Virginia, conditions were not different from 1919. Kentucky reports a general prevalence and, while no exact figures are at hand, the losses were probably greater than in the previous year, while in West Virginia about the average losses occurred.

Group IV includes Tennessee, Virginia and Maryland. In this group Tennessee seems to be the only state where losses were greater than in 1919.

In group V the average loss was in the neighborhood of 3%, which is much lower than for last year and the average. None of the states in this group approached the losses of 1919.

The state collaborators report as follows on bitter rot in 1920:

Massachusetts (Osmun)- Unimportant, prevalence about as usual.

Connecticut (Clinton)- Of little importance, one complaint only.

New Jersey (Cook)- Throughout the state. Appeared earlier than usual (date not given). More than last year.

Pennsylvania (Thurston and Orton)- Severe in Union, Erie, Fayette and Lehigh Counties. Reported from Armstrong, Berks, York, Montgomery, Huntingdon, Center and Adams Counties; mostly on unsprayed home orchards.

Maryland (Temple)- More than in 1919. General.

Delaware (Manns)- Bitter rot severe on some varieties.

Virginia (Fromme)- Much less than last year and less than the average year. Late appearing.

West Virginia (Giddings)- Same as last year and about average. Unimportant.

Kentucky (Valleau)- Very common in all parts of the state.

Tennessee (Hesler)- Worse than average and about the same as last year. Locally serious on summer varieties and generally serious on winter varieties. Generally prevalent except in mountains.

North Carolina (Jehle)- Less than in 1919 and less than average. Occurs all over the state.

Georgia (McClintock)- Same as last year and about average. Not serious. Occurs throughout the state.

Mississippi (Neal)- About the same as in 1919. In northern counties.

Texas (Taubenhaus)- Traces. Unimportant.

Arkansas (Elliott)- General throughout the state. (L. Pierce)- Slight in Benton and Washington Counties. Very little weather favorable to the development of the disease during the summer.

Ohio (Selby)- More than last year but not important. Mostly in southern counties but one Erie County report.

Illinois (Anderson)- Slightly more than last year. Local damage high but of little importance as far as the entire state was concerned. Confined to southern counties. Considerable bitter rot observed in local markets.

Missouri (Hopkins)- Severe.

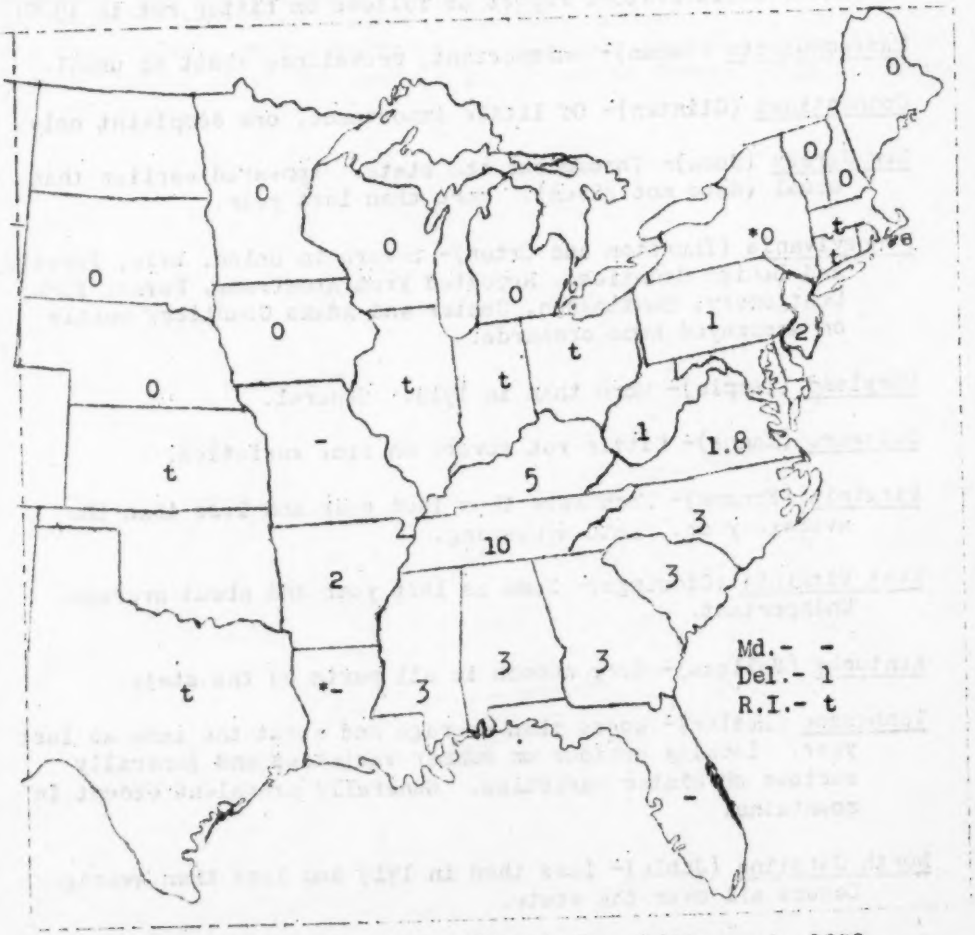

Fig. 5. Estimated percentage losses from bitter rot, 1920.

Losses from Bitter Rot.

Ten of the leading bitter rot states were Virginia, New Jersey, North Carolina, Georgia, Kentucky, Tennessee, Alabama, Mississippi and Arkansas. These states showed a loss of 2,678,000 bushels from the disease in 1920. The total loss from all the states for 1920 was about 2,921,000 bushels, or slightly over one percent of the crop. The loss in 1919 approximated 1.21%, or 2,019,000 bushels. The corrected losses for each state will appear in Supplement 18 of the Plant Disease Bulletin.

Table 7. Losses from bitter rot as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Range of percentage of decay		Origin of shipment	Range of percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent		No. cars	Percent	
Jan. 6-10, 1920			Aug. 21-Nov. 3, 1920 (Continued)			
Virginia	2	6-3				
			New York	1	15	
			Pennsylvania	2	2	
Aug. 21-Nov. 3, 1920			Virginia	1	10	Associated with blue mold rot.
Arkansas	2	6-14				

Total number of cars with decay..... 8
Total number of cars inspected..... 3384

Bitter Rot in Relation to Weather Conditions.

The weather conditions favorable for bitter rot are hot, wet weather during July and August. "Muggy weather" is the term adopted by pathologists to describe the ideal weather for the development of this disease. July was a comparatively cool month over all the bitter rot states, but there was an abundance of rainfall in most sections, with the exception of the southern Illinois and eastern Missouri region and parts of Virginia. Especially heavy rainfall occurred in North and South Carolina and across the northern ends of the southern tier of states. Southern Ohio also had abundant precipitation. During the first three weeks of August heavy rainfalls occurred over most of the bitter rot section with the exception of Illinois, Indiana and eastern Ohio. There was also a dry area in eastern Virginia and along the coast southward. While the precipitation records for the months of July and August would seem favorable for an epiphytotic of bitter rot in the eastern section, the cool weather which has generally followed the rains probably influenced the disease unfavorably. In Indiana and Illinois the dry weather of August probably held the disease in check.

The regions most favorable for the development of bitter rot from the weather standpoint were those of eastern North and South Carolina, western Tennessee and across the northern ends of the Southern States.

Nature of Injury from Bitter Rot.

The question of the presence or absence of distinct bitter rot cankers has been one of considerable interest to students of the disease. It is suggested that the collaborators make a special effort during 1921 to locate cankers in orchards where the disease is especially prevalent and report their findings to the Plant Disease Survey office. It is interesting to note that Jehle in North Carolina and McClintock in Georgia report injury from cankers on the limbs. Fromme in Virginia reports "fruit rot - no cankers". Hesler in Tennessee reports "cankers not abundant so far as I have observed". Anderson in Illinois has searched for distinct bitter rot cankers for several years and has never found

them even when the fruit was badly rotted in the orchards. Do the cankers occur in certain localities and not in others, or are they confined to certain varieti or do they occur under the influence of certain climatic conditions?

Dates of first observation of bitter rot:

New Jersey	- Earlier than usual	Pennsylvania	- July 24, York County
Arkansas	- June	Missouri	- August, St. Charles
Illinois	- July, Flora	Virginia	- August 1, Crozet
Tennessee	- July 16, Jackson	Mississippi	- October 20, College

Varietal Susceptibility.

Susceptible:

Pennsylvania	- Northwestern Greening	Illinois	- Lowell
	Winter Banana		Ben Davis
	York Stripe		Huntsman
	Ben Davis		Grimes
	Chenango		
		Maryland	- Bismark
Tennessee	- Yellow Transparent		Smokehouse
	Early Harvest		Smith Cider
	Ben Davis	Resistant:	
	Kinnard		
	Paragon	Maryland	- Grimes
	Duchess		Jonathan
	Red June		Stayman
	Limber Twig		Winesap
	Jeffrey		York

The inspectors of the Bureau of Markets report bitter rot on Collins Red (Arkansas apples), York Imperial, Winesap (Pennsylvania apples), Maiden Blush, Rambo, "Streak", Chenango, Wealthy, Gravenstein and "Pippin" (Virginia apples).

Control Measures for Bitter Rot.

Few of the collaborators mentioned control measures for this disease in their reports. It would be interesting to learn in which states bitter rot sprays are applied as a general part of the spray program and in which states it is the practice of growers to apply the sprays only when the disease begins to appear. For example, it is the habit of some Illinois growers to watch certain trees where the disease commonly first appears and if bitter rot appears on them they start spraying.

The following reports on control were received from collaborators:

New Jersey (Cook)- Not serious in well sprayed orchards.

Virginia (Fromme)- Copper lime dust and potato dust gave practically no control. Bordeaux mixture very satisfactory.

North Carolina (Jehle)- Controlled by spraying in many orchards.

Arkansas (Elliott)- Good results with Bordeaux.

Illinois (Anderson)- Hand picking when the disease first appears

is generally practiced even in large commercial orchards. Bordeaux applied to susceptible varieties, usually after the first appearance of the disease.

Fire blight caused by Bacillus amylovorus (Burr.) Trev.

All states where apples are grown in any quantity reported blight as present in 1920. East of the 100th Meridian there are three distinct belts as regards the severity of the disease (see Fig. 6).

The northern belt, which suffered most severely from blight, includes the New England States (with the exception of Maine), New York, the Great Lakes Basin, Minnesota, Northern Iowa, and eastern North and South Dakota. The greatest injury in this belt was reported from Wisconsin and Minnesota where an epiphytotic developed late in the season, killing many young trees. This same condition was also reported from parts of New York.

The central belt includes the North Atlantic States, south of Rhode Island. It extends westward across Pennsylvania and West Virginia and includes most of the Ohio Valley and the central part of the Mississippi Valley. West of the Mississippi it includes southern Iowa and northern Missouri and Oklahoma, Kansas and Nebraska. In this belt blight was very mild in the eastern sections, while in the Ohio Valley region it was locally serious, and west of the Mississippi less severe than usual.

The southern belt includes the South Atlantic and Gulf States. Here blight was more severe than in the central belt but not much worse than usual; however, blight is usually a serious factor in these states.

The Rogue River Valley region in the Northwest had an unusual amount of blight as did also sections of California. While prevalent in other sections of the Northwest, blight was reported as about normal. Nevada and

Fig. 6. Distribution of fire blight in the important apple producing states in 1920.

Utah report the disease as worse than last year.

The reports of the state collaborators regarding the severity of the disease follow:

Vermont (Lutman)- Very common locally in large orchards; almost all trees that have much fruit have a considerable percentage of fire blight of the fruit twigs.

New Hampshire (Butler)- Mainly in the form of blossom blight. Injury unimportant.

Massachusetts (Osmun)- Very abundant in most sections. Worse than usual. Moderately important.

Connecticut (Clinton)- More than usual and worse than last year.

New York (Chupp)- Monroe County: "More severe than last year". Orleans County: "Very severe in young orchards." Ontario County: "More destructive than usual." Albany County: "Severe infection." Genesee County: "Unusually severe." Rensselaer County: "Local-severe damage."

New Jersey (Cook)- Less than last year. Throughout state.

Pennsylvania (Thurston and Orton)- Much less than usual.

Delaware (Manns)- Practically none. Delaware and Eastern Shore of Maryland (Roberts, June 2)- "Practically no fire blight".

Maryland (Temple)- On the decrease; not as much as average year. Always important and severe locally. Root rot serious.

Virginia (Fromme)- Much less than last year and less than average year. Severe in southwest corner of state in home orchards.

West Virginia (Giddings)- Relatively unimportant. Less than last year.

North Carolina (Jehle)- Less than last year but about same as average. Generally distributed.

Georgia (McClintock)- Serious. Abundant, due to wet weather in spring. About the same as last year and average year.

Mississippi (Neal)- Very prevalent in the northern part of the state. This disease is especially serious in orchards that are not cultivated, pruned, and properly sprayed.

Kentucky (Valleau)- Not of great importance but generally distributed. Same as average year.

Tennessee (Hesler)- Generally distributed. Not as important as scab, blotch and bitter rot.

Texas (Taubenhaus)- Very prevalent. Very important.

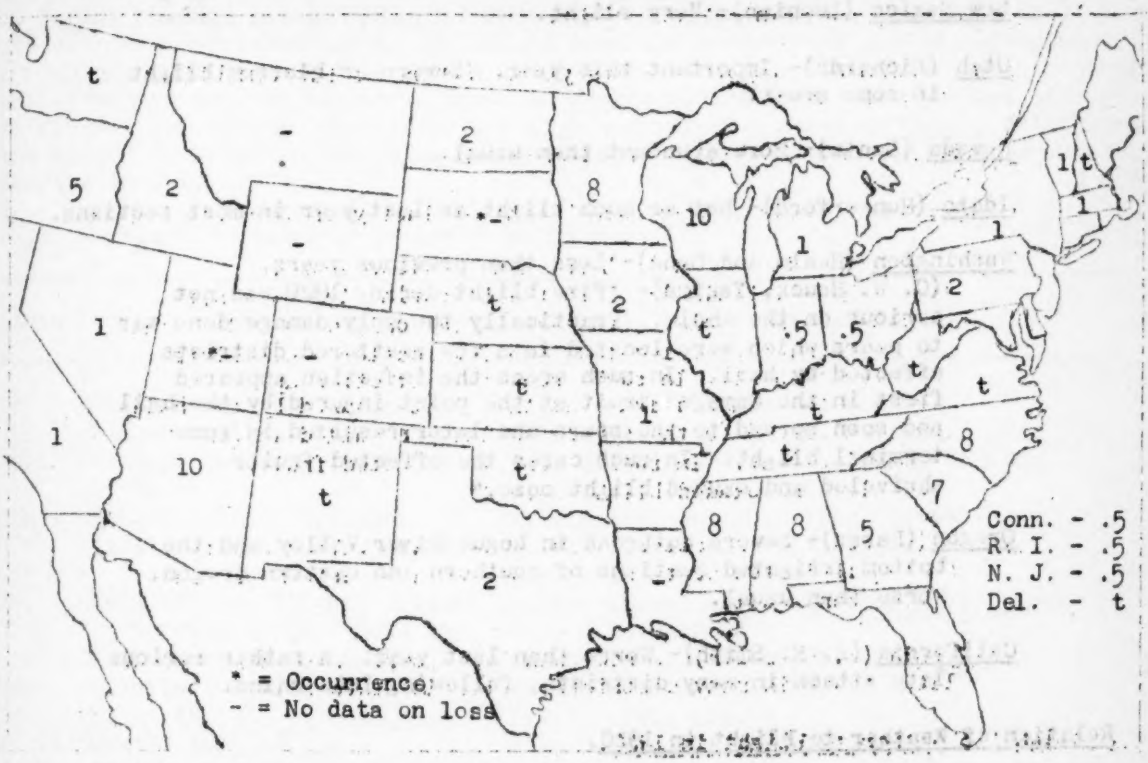

Fig. 7. Percentage losses from fire blight in 1920.

Arkansas (Elliott)- Severe.

Ohio (Selby)- More than average. Developed late in season.

Indiana (Gardner)- Worse than last year. Not serious.

Illinois (Anderson)- Very little early in the season. More serious locally later in the season. Not important.

Iowa (Melhus)- More severe than usual in northern half of state, less than usual in southern.

Wisconsin (Vaughan)- Unusually severe this season. Many young trees have been nearly killed. Developed late in season. (July 1, 1920)

Minnesota (Leach)- General throughout the state and very severe; probably the worst epidemic in several years.

Missouri (Hopkins)- Thought to be moderate.

North Dakota (Bolley)- Very destructive to Siberian Crabs. Observed at Wahpeton, Grand Forks, Fargo and Hillsboro.

Nebraska (Goss)- Present in usual amounts.

Kansas (Melchers)- Probably less than usual. Damage a trace.

New Mexico (Leonian)- Very slight.

Utah (Richards)- Important this year. Severe as blossom blight in some areas.

Nevada (Lantz)- More abundant than usual.

Idaho (Hungerford)- Not as much blight as last year in most sections.

Washington (Heald and Dana)- Less than previous years.
(C. W. Hauck, Yakima)- "Fire blight during 1920 was not serious on the whole. Practically the only damage done was to pears which were located in a few scattered districts affected by hail. In such areas the infection appeared first in the damaged fruit at the point injured by the hail and soon spread to the spurs and later resulted in some terminal blight. In such cases the affected fruits shriveled and exuded blight ooze."

Oregon (Barss)- Severe outbreak in Rogue River Valley and the bottom irrigated sections of southern and eastern Oregon. Worse than usual.

California (E. H. Smith)- Worse than last year. A rather serious late attack in many districts, following late rains.

Relation of Weather to Blight in 1920.

The unusually cold, dry May throughout the upper Mississippi Valley, the Ohio Valley and Great Lakes Basin was very unfavorable for blight in these regions. This was also true in most of the Atlantic States. In the middle of May, when apples were in full bloom through central Ohio, Indiana and Illinois, there was a killing frost. This seemed to have checked any tendency toward early blight of blossoms and twigs in these regions. In the southern ends of these states some blight appeared before this cold period.

In Vermont, Lutman states that "rainy weather during early May and during the blossoming season of the early apples may have been responsible" for the severe blight in that state. McClintock in Georgia states that the wet weather during the spring was responsible for the heavy blight infection.

The striking thing in the behavior of blight during the season of 1920 was the serious epiphytotic which developed late in the season in the upper Mississippi Valley and in New York. By consulting the records of the first appearance of blight, it will be seen that in most cases it was not observed until June or July. The weather records for June show that in Minnesota and Wisconsin there was an unusually heavy precipitation during the latter part of the month, especially June 14-16 and 26-29. Blight began to show up seriously in these states about July 1.

Control of Fire Blight.

Few efforts were made to control this disease according to the reports of the collaborators. Hesler in Tennessee recommended the cutting down of pear trees in the neighborhood of commercial apple orchards on the basis of his observations that the hold-over cankers on the pear furnish the inoculum for

infection in the spring on apple. Selby in Ohio states that "several growers, by prompt cutting and burning of infected parts of pear trees, were able to prevent extended infection by the blight organism on pear and apple". Gardner in Indiana reports that "one grower found that thorough spraying for aphis control was effective against blight". Lantz in Nevada states that "some growers attempt to control the disease by pruning the diseased twigs". Barss in Oregon attributes the severe outbreak in the Rogue River Valley to lack of attention to hold-over cankers in 1919.

Table 8. Nature of injury from blight.

State	Type of injury	State	Type of injury
Vt.	Blossom and spur blight	Ga.	Twig blight and cankers
N.H.	Blossom blight	Miss.	Blossom and twig blight
Mass.	Blossom and twig blight, cankers	Tenn.	Twig and fruit blight, cankers (small limbs)
Conn.	Twig blight on Greenings	Ohio	Twig blight after blossoming
N.Y.	Killing young trees, collar rot, cankers	Ill.	Twig and fruit blight
		Mich.	Blossom blight
Pa.	Twig blossom blight. Blight working further down the branches than usual.	Wis.	Young limbs and some whole trees killed
		Minn.	Twig and limb blight
Va.	Chiefly twig blight	Utah	Blossom blight
Md.	Roots killed	Nev.	Twig blight
W. Va.	Mostly twig blight	Wash.	Blossom twig blight
N. C.	Blossom & twig blight, cankers	Ore.	Blossom blight and limb cankers

Earliest dates on which blight was observed:

Mass. - About May 20
N. Y. - June 21, Monroe County
Pa. - May 17, Adams County
Va. - May 10, Ruther Glen
W. Va. - June 1, Morgantown (Sheldon)
Ga. - Very early
Miss. - July 1, Starkville
Tenn. - May 27, Anderson County
Ark. - April
Ohio - June 12
Ill. - Late
Wis. - July 1, Grant County
Minn. - June 15, Annadale
Mo. - June 5, St. Joseph
N. Dak. - June
Nev. - June 14, Reno
Ore. - May, Medford

Varieties reported as susceptible to blight - 1920:

Hoover - Tenn
Jonathan - Ark. Ill. Md.
Limbertwig - Tenn.
Lowrie - Tenn.
McMahon - Wis. Ohio
Maiden Blush - Ark.
Patton Greening - S. Dak.
Siberian Crab - S. Dak.
Spitzenburg - Idaho, Wash. Ore.
Transcendent Crab - Wis.
Wealthy - Wis. N. D. (less than crab)
Willow Twig - Ill.
Yates - Tenn.
Yellow Transparent - Va. Tenn. Ill. Va.

Vaughan in Wisconsin reports Northwestern Greening as quite resistant.

Blister canker caused by Nummularia discreta Tul.

This disease was reported in 1920 from most of the states in which it is known to occur. In addition Hesler in Tennessee reports it for the first time from that state. Its wide distribution in that state and neighboring states indicates that it has been prevalent there for a number of years. It is probable that it also occurs quite commonly in the Gulf States although it has not yet been reported from Georgia, Alabama, Mississippi or Louisiana. It is suggested that the collaborators in these states examine old Ben Davis orchards for blister canker.

The accompanying map shows the distribution of blister canker and indicates the regions in which it is especially serious. It was prepared by going over all the reports which have accumulated in the Plant Disease Survey office. The first report dates back to 1903 when Evans, in Missouri, showed it to be quite prevalent in that state.

The fact that the Ben Davis variety is so very susceptible has led to an attempt to correlate the relative abundance of this variety with the prevalence and severity of the disease. On the accompanying map the percentage of the whole crop represented by Ben Davis is given for each state where this variety is used to any extent. It is seen that those states having the largest plantings of Ben Davis are generally the states in which blister canker is reported as especially prevalent. The states suffering most injury from blister canker are Ohio, Indiana, Illinois, Kentucky, Missouri, Arkansas, Kansas and Nebraska. The disease is most severe in the southern half of Ohio, Indiana and Illinois, the northwestern section of Arkansas and the eastern half of Kansas and Nebraska. These are the regions where the Ben Davis variety is grown most extensively and past reports from these states show that almost all the loss is on this variety.

Nebraska probably suffers most severely of any of the states from blister canker. This disease is generally considered to be worse in sections having scant rainfall and especially subject to summer droughts, than where the rainfall is more abundant and evenly distributed.

No reports of blister canker have ever been received from states west of Nebraska and Kansas. That the disease is not yet established in the Northwest seems certain from the careful surveys which have been made from time to time by competent pathologists. The conditions in Colorado are not so well known. This state is planted extensively with Ben Davis and Gano, both very susceptible to the disease. However, the fact that the orchards in that region are comparatively young may explain the absence of the disease. The influence of irrigation on this disease is not known. It is predicted that blister canker will cause considerable trouble in the Colorado region when it once gets established.

The reports from state collaborators follow:

New York (Chupp)- Reported in both Hudson River and Lake Ontario regions. Of minor importance.

West Virginia (Sheldon)- Becoming rare about Morgantown. However, it still persists on a few old trees.

Tennessee (Hesler)- Scattering cases found in various parts of the state. Not a real factor but becoming important. One prominent grower says it is the worst enemy of the apple here. (This is the first report of the disease from Tennessee)

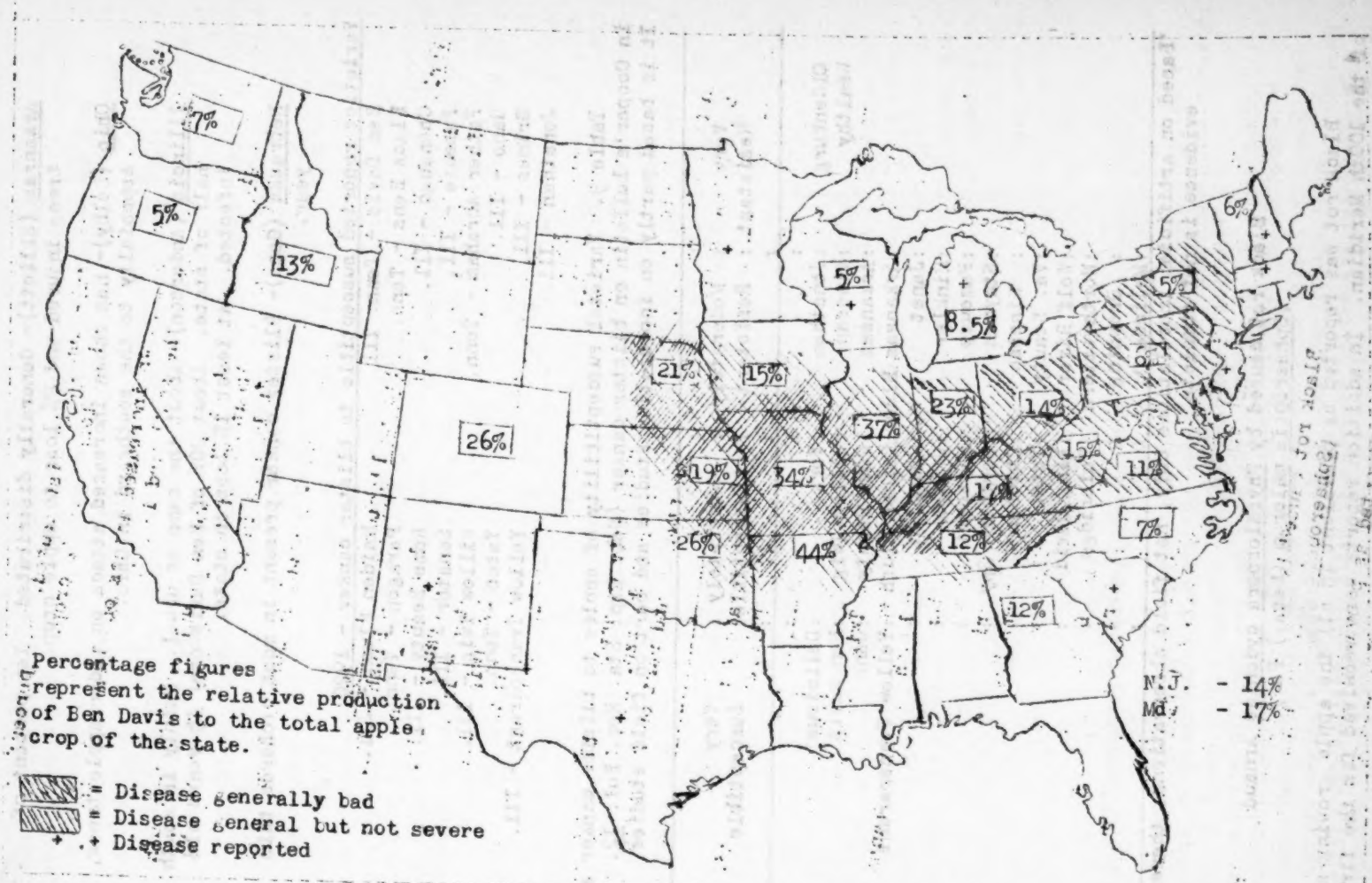

Fig. 8. Occurrence of blister canker in the United States and the percentage of Ben Davis grown in each state.

Arkansas (Elliott)- Generally distributed. Ten percent of trees injured and 2% loss to apple crop.

Ohio (Selby)- Has shown increased attack on older apple trees, especially to the southward in Ohio.

Illinois (Anderson)- About the same as usual. Mainly in south half of state. About 20% of Ben Davis over 15 years old infected. At least 1% loss in state.

Nebraska (Goss)- Blister canker present in most orchards this year.

Varieties reported susceptible to blister canker - 1920:

Ben Davis - Tenn. Ill
Black Bens - Tenn.
Chenango - Ill.
Fameuse - Ill.
Father Abraham - Tenn.
Gano - Ill.
Grimes - Ill.
Jonathan - Ill.
Maiden Blush - Ill.
Paragon - Tenn.
Rome Beauty - Ill.
Senator - Ill.
Willow Twig - Ill.
Yates - Tenn.
Yellow Transparent - Ill.

Table 9. Varietal susceptibility of apples to blister canker as shown in Cooper's bulletin on blister canker (Neb. Exp. Sta. Res. Bul. 12. 1917). It is based partly on inoculation studies and part on field studies.

Very Resistant	Moderately Resistant	Moderately Susceptible	Very Susceptible
Oldenburg	Jonathan	York	Delicious*
Wealthy	Winesap	Willow Twig	Ben Davis
	Arkansas	Rome Beauty	Gano
	Arkansas Black	Maiden Blush	Yellow Transparent
	Janet	Champion	
	Minkler	Grimes	
	Fameuse	Missouri	
	Stayman	Northern Spy	
	Winesap	Chicago	
	Va. Beauty	Yates	
	Wolf River	King David	
	Northwestern Greening	Walbridge	
	Malinda		

*Based on artificial inoculations only, not field observations, therefore, evidence is not complete.

Black rot caused by Physalospora cydoniae Arnaud (Sphaeropsis malorum (Berk.) Pk.)

Black rot was reported as prevalent in all the apple growing states east of the 100th Meridian. In addition reports were received for the first time

from Oregon and California. C. R. Stillinger has investigated this disease in the West and has recently reported his findings. (Phytopath. 10: 453-458. 1920.) He states that Hahn in 1914, in an unpublished thesis, describes a canker of apple trees in California which was caused by a fungus indistinguishable from Sphaeropsis malorum but referred to Diplodia natalensis Evans, on account of the common occurrence of two-celled pycnospores. Stillinger found the true black rot of the fruit to be quite common in Oregon although he was unable to find the canker form. This is not surprising since in many regions of the Mississippi Valley the true New York apple tree canker is rarely found. Barss in Oregon reports "black rot fungus fruiting abundantly on apple bark injured by low temperatures of last December all through the Willamette Valley. No report of serious fruit infections". E. H. Smith in California reports that black rot is "found occasionally along the coast; of some economic importance in Santa Cruz districts". It would seem from these various reports that black rot is not at all rare in the Northwest and that it has occurred in that region in a mild form for a number of years. It is commonly reported on apples from these regions by inspectors of the Bureau of Markets. It would be of interest to know more concerning its distribution in the interior Western

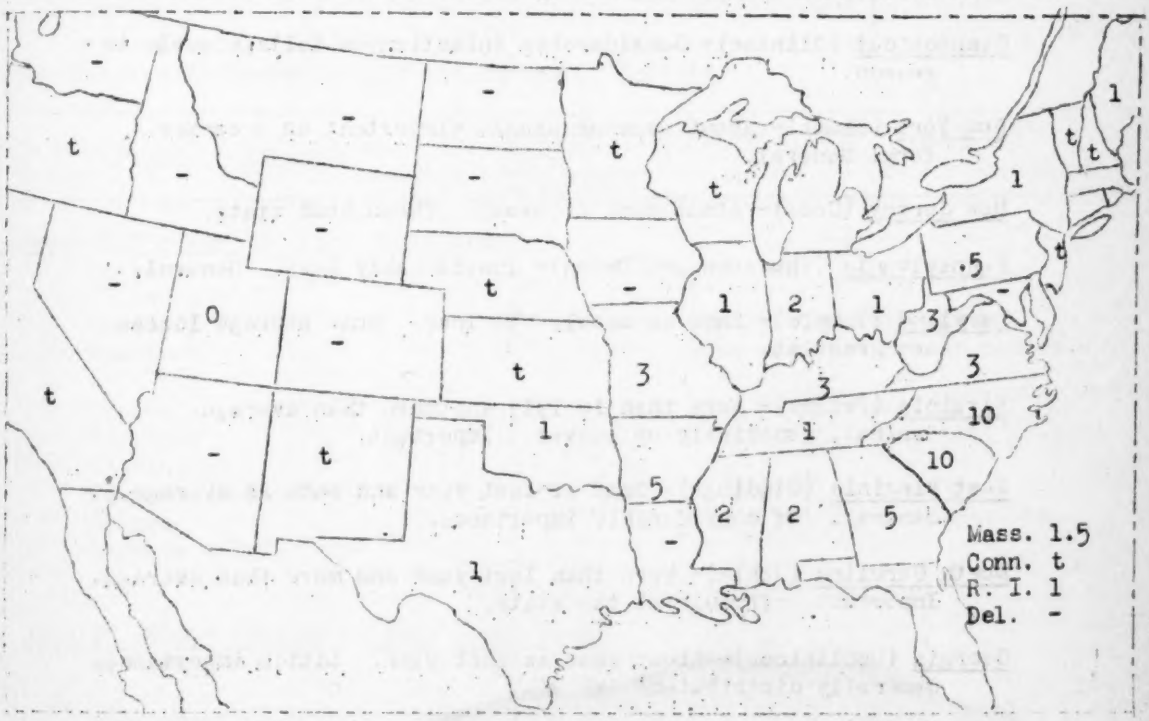

Fig. 9. Estimated percentage losses from black rot, 1920.

States from which it has not been reported yet. It is suggested that the collaborators of these states examine the fruit in the field and in the markets, as well as the trees in the orchard, during the coming season.

The severity of black rot and frog eye leaf spot in the East during 1920 corresponds closely to the conditions in 1919 except that it seems to have been more severe in Virginia and North Carolina as a leaf spot, and less severe in Pennsylvania, where it caused great damage in 1919. As usual most damage was reported in the South Atlantic and Gulf States and fairly heavy infection in the Mississippi Valley.

A noticeable feature of the 1920 reports was the wide prevalence of "blossom end rot" with black rot following. This condition was reported as common in Ohio and Tennessee and was observed in Illinois and Pennsylvania. A more detailed discussion of this type of injury will be given later under the head of "nature of injury".

The percentage loss from black rot throughout the United States was about 1.3% or a total crop loss of 3,660,000 bushels. The loss in 1919 was 1.36% estimated as 2,260,000 bushels. Six of the leading black rot states, New York Virginia, West Virginia, North Carolina, South Carolina and Georgia, show a loss of 2,485,000 bushels or over two-thirds of the entire loss. The corrected loss for each state will appear in Supplement 18 of the Plant Disease Bulletin.

New Hampshire (Butler)- Less than 1919.

Massachusetts (Osmun)- Worse than average and worse than in 1919. Second in importance to scab. (Arout)- Very abundant on leaves and limbs in most unsprayed orchards; some trees being almost defoliated by it.

Connecticut (Clinton)- Considerable infection on foliage early in season.

New York (Chupp)- About same as usual. Important as a canker form. General.

New Jersey (Cook)- About same as usual. Throughout state.

Pennsylvania (Thurston and Orton)- Considerably less. General.

Maryland (Temple)- Same as usual. 5% loss. Home storage losses are greatest.

Virginia (Fromme)- More than in 1919 and more than average. General, especially on leaves. Important.

West Virginia (Giddings)- Same as last year and same as average. General. Of considerable importance.

North Carolina (Jehle)- More than last year and more than average. Important. Throughout the state.

Georgia (McClintock)- About same as last year. Little importance. Generally distributed.

Alabama (Thiel)- Present in the state.

Mississippi (Neal)- About same as usual. Unimportant. Local, mostly in western counties.

Kentucky (Valleau)- Very common.

Tennessee (Hesler)- Generally distributed (as leaf spot and fruit rot). Not serious generally.

Arkansas (Elliott)- Generally distributed.

Indiana (Gardner)- State-wide as a fruit rot and on foliage. About same as last year and average year.

Illinois (Anderson)- Slightly more than usual. Leaf spot more common in southern Illinois where some damage resulted. Blossom end rot observed in many orchards of Ben Davis.

Minnesota reported the leaf spot as local and unimportant, but more than usual.

Kansas (Melchers)- Only a trace in a few orchards.

Oregon (Barss)- Black rot fungus fruiting abundantly on apple bark injured by low temperatures in Willamette Valley. No report of serious fruit infections.

California (E. H. Smith)- Found occasionally along the coast; of some economic importance in Santa Cruz districts.

Table 10. Losses from black rot as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
January 3 - May 20, 1920 (1919 crop)			
Kansas	1	28	
Illinois	1	4	
Missouri	1	7	Mostly blue mold rot.
New York	5	2-10	Blue mold present in nearly every car.
Oregon	3	1-11	Blue mold in one car.
Virginia	12	2-13	Considerable blue mold present.
Washington	6	3-14	" " " "
West Virginia	2	5-10	
Canada	1	13	Black rot and Rhizopus rot.
Unknown origin	1	6	
Total	33		
July 7, 1920 - January 5, 1921 (1920 crop)			
Arkansas	1	57	
	2	14-17	
California	1	3	
Delaware	5	7-17	Some blue mold present.
Illinois	8	2-17	
Maryland	13	2-15	Considerable blue mold present.
Michigan	7	2-15	" " "
New Jersey	1	5	
New Mexico	1	5	
New York	1	40	Mostly pink mold rot.
	28	2-25	
Ohio	5	5-32	
Pennsylvania	9	2-30	Considerable blue mold present.
Tennessee	2	2-4	

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
July 7, 1920 - January 5, 1921 (1920 crop) (Continued)			
Virginia	3	30-47	Pink mold present in one car.
	24	2-23	Considerable blue mold present.
Washington	1	2	
West Virginia	20	2-17	Blue mold in some cars.
Unknown origin	1	65	Black rot, blue mold and Rhizopus
	6	3-10	Blue mold in three cars.
Total	139		

Grand total 172
Total number of cars inspected..... 3462*

*Approximate

Nature of Injury from Black Rot.

It is evident from the reports of the collaborators that the type of injury most prevalent in the different sections is quite distinct. In Virginia, West Virginia, North Carolina and parts of Pennsylvania, the leaf spot or "frog eye" seems to be the most important phase of the disease, although the rotting of the fruit is important in some sections. In the Southern States the canker form as well as the fruit rot appears to be important. In the northern section of the Mississippi Valley the canker form is of little importance, the leaf spot causes practically no damage, while the fruit rot is quite serious, especially where primary injury to the fruit occurs through the attack of insects, hail etc. In these sections the fungus is commonly found fruiting on twigs killed by blight and in old blight cankers. In New York and parts of Ohio and Indiana the canker is more common than farther west. Hesler, who has investigated this disease for a number of years, states that the canker form is rare in Tennessee.

The reports of the Bureau of Markets indicate that black rot on the fruit occurs most commonly on apples from New York, Maryland, Pennsylvania, Virginia, West Virginia, Illinois and Ohio. The large number of reports from these states is, in part, due to the larger number of barrels shipped from the states. It is interesting to note that a number of reports of black rot on northwestern apples are found in the 1920 records of the inspectors.

Defoliation as a result of the leaf spot was reported as especially prevalent in Massachusetts (Krout and Osmun), North Carolina (Jehle), Virginia (Fromme), and southern Illinois (Anderson). Fromme states that the effect of leaf spot is very noticeable the year following the injury, in the reduction in quantity and size of fruit. This point should be borne in mind by the collaborators in making their reports.

A type of injury which has received unusual attention this year is that commonly called "blossom end rot". This is thought to be primarily due to sprays, probably arsenicals, and manifests itself as a black circular area about the calyx end. It is most common on Ben Davis in Illinois and appears especially where the trees have been undernourished, as is true of other types of spray injury. While this is probably a spray injury, it has been noted by several of the collaborators that black rot almost invariably follows such

injury. Hesler in Tennessee states that Delicious, Ben Davis, Black Bens, Red June and Winesaps are subject to this end rot.

Dates of earliest observations of black rot:

In most cases the collaborators failed to state whether their observations were on the "frog eye" of the leaf or rot of the fruit. The early reports are, without question, of the leaf spot. It would be well for the collaborators to indicate in their reports on this point the nature of the injury first observed.

State	Date	Place
New York	June 2	Monroe County
New Jersey	June 25	Beverly (Haskell)
Pennsylvania	July 10	Center County
Virginia	May 21	Blacksburg
Georgia	April 30	Fort Valley (Roberts)
Mississippi	April 24	New Albany (Roberts)
Tennessee	May 27	Lancing
Arkansas	May	
Ohio	June 1	
Indiana	May 28	Morgan County
Illinois	May	Anna
Missouri	May 17	Springfield

Control of Black Rot.

No special spraying operations for the control of black rot were reported by the collaborators for 1920. Several stated that the disease was not prevalent in well sprayed orchards. It is evident that the regular spraying operations are depended upon to control black rot.

From observations in Illinois it is evident that the use of nitrate of soda will reduce the amount of blossom end rot and thus reduce the chance of secondary infection. In one orchard where the owner had applied sodium nitrate to about two-thirds of his orchard and none to the other third, blossom end rot was prevalent in the untreated part to the extent of at least five percent, while in the nitrated part none could be found.

Any factor which reduces the amount of injury to the fruit will materially reduce the fruit rot. The amount of rot on the fruit in Illinois is directly proportional to the percent of codling moth and curculio injury in most orchards.

Hesler in Tennessee states that these varieties which blight badly are the varieties which suffer most from "frog eye" since the fungus winters on the blighted twigs and the spores are washed from these on the leaves.

Rust caused by Gymnosporangium juniperi-virginianae Schw.

In 1920 apple rust was far less prevalent and less destructive than in 1919. The only region which suffered any great loss was the Virginia-North Carolina district. Even in Virginia the percentage loss dropped from 15 in 1919 to 5 in 1920. Severe losses were sustained in Arkansas where eradication of the cedars had not been practiced.

No new records of the distribution of rust were obtained. A complete summary of the rust situation in the United States is given in the Plant Disease Bulletin, Supplement 9, and the reader is referred to this for more detailed information concerning the distribution of the disease.

The following reports were received from the collaborators concerning the distribution and relative prevalence of the disease in 1920:

Massachusetts (Osmun)- About as usual. Unimportant.

Connecticut (Clinton)- Average same.

New York (Chupp)- About same as average year; both on fruit and foliage. On Long Island and in Hudson Valley only.

New Jersey (Cook)- Same as usual in a few localities only.

Virginia (Fromme)- Very severe again in the Shenandoah Valley region except where protection has been obtained by cedar eradication. Unusually severe in counties east of the Blue Ridge. Damage as a whole was less, owing to eradication of cedars in important commercial section.

West Virginia (Giddings)- Very general over state. Unimportant this year. Less than average and less than last year.

North Carolina (Jehle)- About same as last year and average year. Unimportant.

Kentucky (Valleau)- Common over most of the state. Apparently not serious.

Tennessee (Hesler)- General over state. Important only in local areas.

Georgia (McClintock)- General over state. Unimportant.

Alabama (Thiel)- Present in the state. No data on damage.

Mississippi (Neal)- Local. Unimportant. Less than last year and less than average.

Alabama (Elliott)- Extremely severe in regions where cedars are plentiful. Trees defoliated in July and August. Mostly in northwestern part of state.

Ohio (Selby)- More than usual. Mostly in the Ohio Valley region.

Indiana (Gardner)- Mostly in southern half of state where red cedars are abundant.

Illinois (Anderson)- About same as usual. Mostly in extreme south (Union and Johnson Counties). Some in western section.

Iowa (Melhus)- Less than last year.

Minnesota (Leach)- Not very prevalent; over southeast quarter of state.

Wisconsin (Vaughan)- Less than average, along Mississippi River bluffs.

Kansas (Melchers)- Present but no damage to speak of.

Fig. 10. Percentage loss from apple rust as estimated for 1920.

Nature of Injury from Rust.

Three types of injury result from the attack of Gymnosporangium juniperi-virginianae; (1) Injury to the foliage, resulting in reduced assimilating surface. In some cases defoliation results; thus Elliott in Arkansas reports that "trees (Jonathans) were defoliated in July and August". In other cases a scorching of the leaves similar to spray burn occurs. This condition was reported by Fromme on Black Twigs in Virginia. The foliage injury resulted in dwarfing the tree and reducing the size and quantity of the fruit. (2) Injury to the fruit. It appears that fruit infection is common on some varieties and rare on others. There is also great variation in this respect

from season to season. Melchers in Kansas reported leaf infection as common but "fruit is never affected". In southern Illinois leaf infection was very common and abundant but the fruit was rarely rusted. (3) Injury to twigs. Twig infection is much like fruit infection in the matter of wide variation. Hesler reported twig infection common on Red June in Tennessee. It was also common on Smith Cider in Illinois and Virginia. On commercial varieties, however, it does not seem to be of any importance.

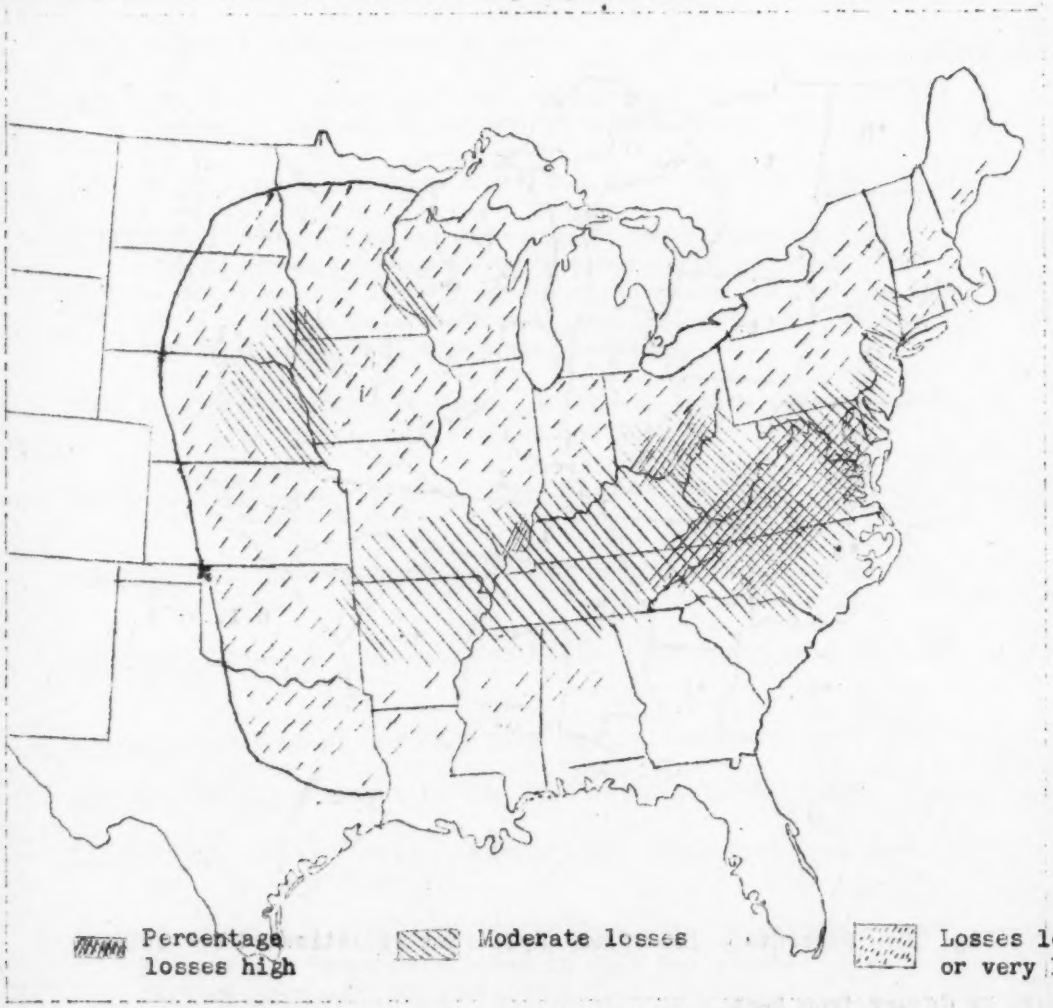

Fig. 11. Occurrence of apple rust in 1920 and distribution of red cedars.

Relation of Weather to Rust in 1920.

In the principal rust region, West Virginia, Virginia and North Carolina, May was unusually dry, cool month. This, together with extensive cedar eradication, explains the percentage reduction in rust in these regions. In Ohio the northern section was dry during May but in the southern section, where most of the rust occurs, the precipitation was above normal. This was true

also in southern Indiana and Illinois. Excessive rainfalls occurred in the northwestern section of Alabama and this was probably responsible for the heavy infection in this state where the cedars were not eradicated.

More information is necessary concerning the time of infection of the rust fungus before accurate statements can be made concerning the relation of the weather to the prevalence of the disease.

Dates of first observations of rust on apple:

In addition to the information furnished by the collaborators as given below, Hesler in Tennessee made a number of observations on the development of the spore horns of the cedar apples and the time of opening of the aecia.

"Development on cedar - Knox County, Tennessee.
March 20: Galls with horns just beginning to break through.
March 24: Horns 1/16" long.
March 28: Horns 3/16" long. Rain fell night of 27 and on morning of 28 at 9 a.m. trees still wet.
April 2 : Horns 1/4 to 3/4" long and had discharged a crop of sporidia.
"Development on apple.
June 3 : Pycnia, no aecia (Sevier County).
June 20 : Aecia just beginning to show.
July 6 : Aecia just breaking through.

"Subsequent to April 2, galls apparently functioning repeatedly, single galls producing several crops of sporidia (number not determined)."

State	Date first observed	Place
Connecticut	July 12	Old Saybrook
New York	July 6	Poughkeepsie
Pennsylvania	July 22	Lebanon County
Virginia	June 2	Harrisonburg
Tennessee	June 3	Pigeon Ford
Illinois	May 23	Anna
Minnesota	July 2	
Wisconsin	About June 1	Gays Mills
Missouri	July 17	Southland

Varietal Resistance to Apple Rust.

A summary of survey data concerning susceptible and resistant varieties from 1905 to 1919 appeared in last year's fruit disease summary (Pl. Dis. Bul. Suppl. 9: 108, 109. 1920). The following susceptible varieties were mentioned in the 1920 reports:

Ben Davis - Tenn.
Benoni - Ill.
Champion - Tenn.
Jonathan - Ill. Ind.
Red June - Tenn.
Rome Beauty - Md.

Commerce - Tenn.	Senator - Tenn.
Delicious - Tenn.	Stayman - Penn.
Early Harvest - Tenn.	Wealthy - Mass. N.Y. Tenn. Ill. Ia. Minn.
Fanny - Penn.	York - Penn. Md.

Hesler in Tennessee makes the observation that "in one orchard Champion and Ben Davis were very susceptible while Delicious was moderately susceptible". Patten and Northwestern Greening were mentioned as showing some resistance in Minnesota.

Table 11. Summary of a questionnaire to growers in Virginia as to varieties affected and not affected in 1920.

No. growers reporting	Affected	No. growers reporting	Not affected
6	York	3	Winesap
4	Ben Davis	1	Delicious
1	Jonathan	1	Stayman
1	Shockley	1	Black Twig
1	Rome Beauty	1	Borum

Control of Apple Rust.

The only method of control reported by collaborators was that of cedar tree eradication from the neighborhood of orchards. That this method is materially reducing the rust in large commercial apple growing sections is indicated by the reports of this year. Thus in New York Chupp stated that "removal of all cedar trees for one half mile from an orchard reduced the rust about 90%". Fromme in Virginia stated that "Frederick County cut practically all cedars and has practically no infection. Damage less, owing to eradication of cedars in important commercial sections." The small amount of damage by rust in Arkansas in spite of an ideal season for its development, can be attributed to the cedar eradication in that state. Elliott stated "extremely severe in regions where cedars are plentiful, 85% of cedars cut in commercial apple sections". In West Virginia, where eradication of the cedars has advanced farther than in any other state, the damage this season from rust was reported as "unimportant".

Efforts to eradicate cedars in Union County, Illinois, were made by the State Department of Agriculture. The cedars were declared a nuisance and were ordered removed by January 1, 1921, in the neighborhood of Anna. The success of this movement cannot be determined for several seasons.

For further data concerning eradication see Plant Disease Bulletin, Supplement 9, pages 10-12.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall occurs wherever apples are grown in the United States. The prevalence of the disease in various sections of the country is indicated by the fact that nearly every state in the Union has reported it as "general" or "common" during the past fifteen years. It is a serious nursery trouble in all sections and the wide dissemination of nursery trees, together with the fact that it has a wide range of hosts, has assured a general distribution of the

disease. The reports in 1920 do not indicate any serious trouble from the disease but this is not surprising, considering the difficulty both in locating the diseased trees and in determining the amount of damage.

The effect of crown gall on young orchards has been investigated and reported on by the Iowa Station (Ia. Agr. Exp. Sta. Res. Bul. 50). The results show that planting crown galled trees does not decrease the stand; that crown galled trees did not grow nearly so rapidly as healthy trees; that it is not uncommon for galled trees to recover after they are set in the orchard; that large galls seem to be more injurious than small ones; and that soft galls are more injurious than hard ones. Unfortunately, no data on yield from galled and healthy trees are yet available. It is commonly claimed by nurserymen that trees suffering from crown gall yield as well, if not better, than healthy trees.

The actual loss to nurseries from crown gall is not reported generally by the collaborators. This information can be secured, in many states, from the state nursery inspectors. It is suggested that collaborators make an effort to secure data from these inspectors in 1921. The loss in this branch of the industry must have been very large during the past year on account of the high price of trees and the scarcity of nursery stock. In one of the largest nurseries of the Mississippi Valley section it was estimated that 10 to 20% of the apple trees were discarded on account of crown gall in 1920. They estimated the money loss to be about $40,000.

From unpublished data which Dr. I. E. Melhus, of Iowa, kindly furnished, it is shown that the average loss in a nursery where counts of discarded trees were made was 19.24%. About 20,000 trees are usually set per acre in the nursery plantings. Melhus finds that the stand when the trees are ready for lifting is 57.2% of this, or 11,440 trees on account of loss of plants from various causes. If the loss from crown gall averages 19.24% the number of trees discarded per acre would be 2,196. At present nurseries are selling their entire output and could sell more; thus they lose the equivalent of the sale price of about 2,200 per acre.

It is probable that crown gall is decreasing in many sections of the country as regards orchard crops, on account of the more thoroughly organized nursery inspection service in most of the apple growing states, and the realization on the part of nurserymen that they cannot sell diseased stock to most commercial orchardists.

Varietal susceptibility is not mentioned by the collaborators except that Hesler in Tennessee stated that the aerial form on Early Harvest is common all over the state. This is also true of southern Illinois. Greene and Melhus, in the bulletin referred to above, stated that when Wealthy and Jonathan were planted in infested soil, Wealthy showed 62% crown gall while Jonathan showed only 13% at the end of four years. Nurserymen state that this difference in susceptibility is noticeable in the nursery.

The so-called "aerial crown gall" has received more attention than usual in the 1920 reports. Whether or not this type of gall is always due to Bacterium tumefaciens is still an open question as far as the apple is concerned. It is found on Chonango in Illinois wherever this variety is grown and is regarded by orchardists as a characteristic feature of this variety. It is also quite commonly found on Early Harvest as was mentioned earlier.

In New York Chupp reported crown gall as not important and probably the same as the average. At Riverhead "one tree was pretty well covered with galls". (aerial galls ?). In Tennessee Hesler reported the disease "severe in nurseries as well as in orchards; aerial form bad on Early Harvest all over state; a big problem here". Taubenhaus in Texas regarded crown gall as "fairly important" and generally distributed, especially on nursery stock. In Arkansas

Elliott reported 10% of the crop injured. Melhus in Iowa, who has made a special study of the disease, stated that 22% of the apple nursery stock is suffering from crown gall, and that the loss is 12% for 1920. This high estimate, by one who has made a careful study of the disease would indicate that the loss is being greatly underestimated in other sections of the country. In Idaho the disease was considered as "not serious". Heald and Dana in Washington stated that the "aerial form is not uncommon on the west side".

Sooty blotch and fly speck caused by Leptothyrium pomi (Mont. & Fr.) Sacc. and Phyllachora pomigena (Schw.) Sacc.*

The following reports from state collaborators concerning these diseases have been received:

Pennsylvania: Quite generally reported on York, Stayman, Spy, Greening, Rome Beauty, Fallawater, Wealthy. Worse than usual on account of late rains. Important in unsprayed orchards. Not important where late sprays were applied.

West Virginia: General throughout the state. About the same as average. Important commercially. Easily controlled by the usual sprays.

Maryland: One percent injury.

Tennessee: Considerable damage to quality. Often 100% of fruit on the local market affected.

Arkansas: Abundant on unsprayed fruit.

Ohio: More than usually prevalent. Damage small. Wet season has been favorable for the fungi. July copper sprays gave excellent results.

Indiana: Worse than last year. Not of great importance.

Illinois: Of no importance to the commercial crop. Some locally important. Poor site and indifferent spraying and pruning responsible for most of the trouble.

It is evident from these reports that sooty blotch and fly speck caused very little trouble in 1920. It was found generally distributed as usual and was perhaps more prevalent in New York, Pennsylvania and Maryland than usual.

*A general summary of this disease was given in Plant Disease Bulletin Supplement 9: 122-215. 1920.

Table 12. Losses from sooty blotch caused by Leptothyrium pomi, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of sooty blotch		Origin of shipment	Percentage of sooty blotch	
	No. cars	Percent		No. cars	Percent
Jan. 1 - Apr. 5, 1920			Sept. 11 - Dec. 28, 1920:		
Maine	2	12-63	(Continued)		
Massachusetts	1	17	Maryland	1	57
Virginia	4	6-32	New Hampshire	1	19
West Virginia	1	25	New York	2	10-14
Total	8		Pennsylvania	2	2
			Virginia	3	3-27
Sept. 11 - Dec. 28, 1920:			West Virginia	4	4-45
Delaware	1	10	Total	14	

Grand total..... 22
Total number of cars inspected..... 3384

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm.

Powdery mildew was prominent in several states east of the Mississippi this year but as usual caused no serious trouble except in nurseries where it checked the growth in some instances. In New York it was reported as more common than in 1919 but not of much importance. It occurred mostly in the Lake Ontario region and appeared in Monroe County June 18. In some sections it was serious enough to dwarf the growth of the new shoots. It was reported from West Virginia as not causing much damage this year. Maryland reported the disease locally severe on nursery stock. In Ohio Selby reported it as more prevalent than in 1919. At Ladoga, Indiana P. J. Anderson observed mildew on Missouri Pippin, causing some dwarfing of shoots. In Idaho Hungerford stated that it was present in neglected orchards, but less serious than last year.

In the Northwest, where mildew is usually a rather serious factor in the orchard, the damage was less than in 1919. Heald and Dana reported less than average in Washington, while Barss reported it "general, as usual, throughout Oregon". In both these states it is fairly well controlled by the usual lime-sulfur scab sprays.

D. F. Fisher, in Farmers' Bulletin 1120, 1920, writes in regard to the nature of the injury:

> "The disease frequently stunts the fruit and produces a disfiguring russeted appearance. ***** The chief loss, however, results from its attack upon the foliage, which, in severe cases, so devitalizes the tree that it fails to produce fruit buds and causes a crop failure the succeeding season."

He reported as most susceptible, Jonathan, Yellow Bellflower, Yellow Newton, Esopus (Spitzenburg), Black Ben, Grimes and Rome Beauty. White Pearmain and Winesap are given as quite resistant. His report on mildew during

the season of 1920 follows:

> "In the irrigated apple-growing districts of Central Washington powdery mildew gave promise of developing to an alarming degree in the early part of the season, but the advent of a period of very hot, dry weather checked the spread of the disease about the first of July. The foliage was therefore not abnormally affected, except in certain sections where the disease has been established a long time. But the exceptional prevalence of mildew during the early part of the season, at and immediately following the blossoming period, when fruit infection takes place, resulted in the disfiguring of a considerable portion of the crop through russeting of the apples. This injury was common on Jonathans, Grimes, and Black Ben Davis as well as other susceptible varieties."

Chas. W. Hauck, Acting District Horticultural Inspector of the Washington State Department of Agriculture, writes regarding powdery mildew:

> "The weather conditions in the spring of 1920 were not conducive to its development. Furthermore, we have been successful in spreading pretty thoroughly the gospel according to D. F. Fisher, of the Division of Fruit Disease Investigations, and as a result the growers have been combating this disease with much success. Whereas, last year the spurs showed the effects of the severe damage done during the previous summer, this year the spurs appeared to be in good condition and indicate that relatively little damage is to be expected from mildew during the coming season."

Fruit spot caused by Phoma pomi Passer

Phoma fruit spot seems to have attracted little attention in 1920 as compared to 1919.

Clinton in Connecticut reported an average amount, with no figures as to percent. Chupp in New York stated that the disease was about the same as last year. It was confined to the Hudson Valley. A trace was present in most orchards although some orchards ran as high as 20%. The earliest report was from Columbia County on June 13. In Delaware Manns stated that the disease marked some of the early varieties from which the last scab spray was omitted. In West Virginia, where there was a heavy loss in 1919, the disease was reported as unimportant and less than during the average year, mainly in the northern section of the state. The condition in Arkansas was also in sharp contrast to last year when a 25% loss was reported on some varieties. Elliott reported very little in the state and only 1% of the crop injured. In the Ozark section of Arkansas and Missouri Pierce reports the disease as very slight, causing less than 1% loss, whereas, in 1919 there was a depreciation of fully 60% of the crop of all susceptible varieties. The disease was also reported in Ohio and Illinois with no serious loss in either state. Good control by spraying was reported from Arkansas.

Anthracnose caused by Neofabraea malicorticis (Cord.) Jackson

This disease is found only in the Northwest where it is especially serious west of the Cascade Mountains in Washington and Oregon. During 1920 the disease caused very severe injury in this region. The reason for this unusual severity is explained below.

Oregon (Barss)- Great severity and general distribution of this disease throughout western Oregon. Damage to trees and crop was severest in years. The severe freeze of last December rendered bark tissues subject to a spread of infections at a rate often many times greater than usual. A big crop and scarce labor last fall resulted in great delay or even abandonment of fall anthracnose spray with consequent rapid increase in number of infections.

Washington (Heald and Dana)- More than average year. Disease on the increase probably on account of the severe winter.

Table 13. Losses from anthracnose caused by Neofabraea malicorticis, as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
February 5 - May 5, 1920			
Oregon	12	1-14	Associated with blue mold in 2 cars.
Washington	8	1-23	
Total	20		
December 13 - 30, 1920			
Oregon	4	3-25	Associated with blue mold in 2 cars.

Grand total 24
Total number of cars inspected.....3384

European canker caused by Nectria galligena Bres.

A summary of the occurrence of this disease in the United States appeared in the Plant Disease Bulletin, Supplement 1, page 14, 1919. In 1920 it was reported from only three states, New York, Virginia and Illinois, and in none of these was it regarded as important. These are the first reports of European canker from Illinois and Virginia. It was found in a single tree at Meekin, Stephenson County, Illinois. In Virginia Fromme reported it from Jonesville. No doubt this fungus is present in other states but is so rare that it escapes observation.

Root Rots Caused by Various Fungi

Xylaria root rot. This is still regarded as one of the most serious problems for the fruit grower in the Shenandoah Valley and other parts of Virginia, North Carolina and West Virginia. The pathologists who attended the fruit disease conference in the Valley in August will agree with Fromme that this disease is the most serious with which he has to contend, as far as apples are concerned. It seems probable that this will prove to be the case in other sections of the country, especially to the west of the Appalachian Mountains in Kentucky and Tennessee. Valleau in Kentucky reports that Xylaria root rot is "probably the most serious apple disease" and "apparently in all sections where apples are grown". This is the first report of the disease received from Kentucky. Hesler in Tennessee reported the disease as "of some importance" and suggested that it is "a problem that needs attention not only in Tennessee but elsewhere". In Illinois the territory where the disease was found was extended during the past year by finding a rather seriously infested orchard in Jackson County. It is a comparatively rare disease in the state and is found only in the extreme southern end. New York (Chupp)- According to the reports of field assistants, this trouble (Xylaria and Armillaria root rots) is becoming more serious each season. From one tree to 10% of the trees in 50% of the orchards are affected. Close plowing, winter injury, etc., have more influence seemingly than weather. Reported more often on Twenty Ounce, Baldwin, Duchess and Kings, in the order named. Elliott in Arkansas stated that the disease is general but not severe.

Armillaria root rot reported as follows:

New York (Chupp)- See above under Xylaria root rot.

Arkansas (Elliott)- Reported Clitocybe and Armillaria root rots as common.

Oregon (Barss)- General causing occasional damage in most orchard sections. Trees girdled below ground and die. All fruit crops susceptible.

Texas root rot (Ozonium omnivorum Shear). The only state reporting on this disease in 1920 was Texas, where it is regarded as very important. Taubenhaus estimates the loss at 2%.

Root rots undetermined.

Illinois (Anderson)- A serious root rot, caused evidently by some "mushroom" type of fungus, was found causing the death of about 10% of Ben Davis trees in a large commercial orchard at Princeton, Illinois. This orchard was planted on the site of an oak forest and a large oak woods bounded it on two sides. No fruiting bodies were found. The fungus strands were white and rather delicate - less than 1/8" in diameter.

Pink rot caused by Cephalothecium roseum (Fries) Cda.

This rot was reported as more abundant than usual in Tennessee, Ohio, and Illinois. It caused "considerable loss, following scab" according to Hesler in Tennessee. In Illinois it was very common on apples in the local markets on account of the abundance of scab. The reports of the inspectors of the Bureau of Markets on this disease are given in the accompanying table.

Table 14. Losses from pink mold rot caused by Cephalothecium roseum, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Feb. 19 - May 19, 1920			
New York	3	4-22	
Unknown origin	2	40-58	Associated with blue mold rot.
Total	5		
Sept. 28, 1920-Jan. 6, 1921			
Illinois	1	13	Pink mold and blue mold rots.
Michigan	1	11	" " " " " "
New York	3	50-65	Considerable amount of other decays
	6	27-40	present, principally blue mold,
	15	2-20	black, and brown rots.
Virginia	2	7-38	Some black rot present.
West Virginia	1	3	Following scab.
Total	29		
Grand total			34
Total number of cars inspected			3462*

Rhizopus rot caused by Rhizopus sp.

Table 15. Losses from Rhizopus rot caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay.
February 11-March 30, 1920			
Massachusetts	1	55	Some blue mold also present.
Canada	2	12-50	Blue mold in one car, black rot in the
Total	3		other.
July 13 - Nov. 4, 1920			
Delaware	3	4-32	Blue and gray mold rot in one car.
Illinois	2	3-11	Brown rot in one car.
Maryland	2	2	Black and brown rots in one car.
New York	2	3-13	Mostly black rot in one car.
Pennsylvania	1	5	
Virginia	1	4	Mostly blue mold rot.
Unknown origin	1	65	Mostly black rot with some blue mold.
Total	12		
Grand total			15
Total number of cars inspected			3462*

*Includes the reports examined for the period February 24, 1920, to January 10, 1921.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

No doubt this rot was general throughout the fruit regions of the country but few of the collaborators reported it as especially injurious. The scarcity of reports this season indicates that it was of little importance from the field standpoint. Its importance from the storage and transit standpoint is indicated by the reports of inspectors given below. The fact that other rots were reported as common in most cases where cars were inspected, leads one to believe that the quality of the fruit was below normal and conditions of storage were poor. In Arkansas the disease was reported as common, with 1/3 of 1% loss to the crop. Washington - less than usual. In New York it was reported from Dutchess County as "showing up severely on a few trees of Chenango". This variety is notoriously susceptible to brown rot in Illinois - Anderson. Oregon reported it as very slight and not of economic importance, occurring as a fruit rot mostly on injured fruit.

Table 16. Losses from brown rot caused by Sclerotinia sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Jan. 29 - Apr. 22, 1920			
California	3	6-25	
Maine	3	4-20	Mostly complete decay.
New York	2	17-23	Serious decay.
Virginia	4	3-9	
Washington	2	10-20	Some blue mold in one car.
Canada	3	20-35	
Total	17		
July 23, 1920 - Jan. 5, 1921:			
Delaware	2	7-25	Blue mold present in one car.
Illinois	1	11	Brown rot and Rhizopus rot.
Maryland	2	2-9	
Michigan	1	1	Brown rot and blue mold rot.
Missouri	1	2	
New York	2	40-57	Mostly pink mold rot.
	12	2-19	Considerable blue mold present.
Ohio	1	10	
Pennsylvania	1	7	
Virginia	5	2-25	Considerable other rots present, mostly blue mold rot and black r
West Virginia	3	3	Some blue mold rot present.
Canada	1	73	" " " " "
Unknown origin	3	3-7	
Total	35		

Grant total..... 52
Total number of cars inspected..... 3462*

*Approximately

Blue mold rot caused by Penicillium expansum (Ld.) Emend. Thom.

The loss from blue mold is usually insignificant as far as the apple crop on the trees is concerned but it becomes a very important factor from the time the fruit begins to be handled until it is finally consumed. In storage and transit it is the most important by far of all the rots. It is impossible to secure accurate estimates of losses in local markets and home storage, but there is little question but that this amounts to over ten percent of the crop thus handled. The losses as reported by the inspectors of the Bureau of Markets indicate the seriousness of this disease.

Table 17. Losses from blue mold rot caused by Penicillium expansum, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
Jan. 2 - June 17, 1920			
California	2	25-55	
	10	3-21	
Colorado	4	25-47	Advanced stages of decay.
	41	2-20	
Illinois	4	32-62	
	5	4-9	
Kansas	1	10	
Maine	17	2-30	
Maryland	2	10-13	
Massachusetts	2	5-55	
Missouri	4	3-21	
Montana	1	2	
Nebraska	1	3	
New York	4	32-67	
	22	2-23	Other decays present in some cars.
Ohio	2	30-40	
Oregon	8	25-47	
	137	1-23	
Pennsylvania	3	4-6	
Virginia	31	2-18	Black rot present in several cars.
Washington	7	50-67	Some complete decay.
	56	25-45	Considerable complete decay.
	1269	1-24	" " "
West Virginia	3	7-20	
Unknown origin	3	50-58	Pink mold rot in one car.
	5	20-40	Some pink mold rot in one car.
	9	3-17	
Canada	6	37-58	Considerable complete decay.
	8	2-17	
Total	1667		
July 10, 1920 - Jan. 10, 1921:			
Arkansas	1	10	
California	7	2-7	

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
July 10, 1920 - Jan. 10, 1921: (Continued)			
Colorado	6	4-22	
Delaware	5	7-18	Considerable black rot present.
Idaho	13	2-33	
Illinois	10	2-20	
Indiana	1	3	
Kansas	1	25	
Maine	2	4-32	
Maryland	21	2-33	Considerable black rot present.
Michigan	36	2-15	
Missouri	1	19	
New Hampshire	1	3	
New Mexico	1	2	
New York	8	25-57	Considerable other decays present
	144	1-23	principally black rot.
Ohio	7	2-18	Black rot present in four cars.
Oregon	28	2-25	
Pennsylvania	2	30-60	Bad decay, some black rot.
	11	2-18	
Utah	3	4-12	
Virginia	32	2-47	
Washington	56	1-15	
West Virginia	21	2-25	Considerable black rot present.
Unknown origin	1	65	Black rot and Rhizopus also pres
	11	2-10	
Canada	1	72	Mostly brown rot, some blue mold
Total	431		

Grand total..... 2098
Total number of cars inspected..... 3462*

*Approximate.

Jonathan spot (non-parasitic)

This trouble seems to have caused very little injury during 1920 and few reports were received from the collaborators. New Jersey reported Jonathan spot as due to Alternaria sp. and states that it is widespread. Indiana (Gardner) reported it worse than usual, occurring on ripe fruit on the trees. It was observed on Jonathan, King and Black Twig. Ohio reported less than usual. Illinois reported very little in the orchards but it was quite commonly observed on fruit in the market. The high price of containers forced growers in this section to attempt to sell their fruit in bulk. The fruit was allowed to stay on the trees longer and was frequently kept out of storage for a considerable time. This resulted in more Jonathan spot appearing on market fruit early in the season. Wisconsin reported less than average and regards the disease as of very minor importance this season. In Idaho it was stated

that the disease was common but less than last year. No estimate is given of the loss or its relative importance. Washington reported the disease as among those present.

Table 18. Losses from Jonathan spot (probably non-parasitic), as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Origin of shipment	Percentage of decay	
	No. cars	Percent		No. cars	Percent
Jan. 28 - Mar. 12, 1920:			Sept. 23, 1920-Jan. 5, 1921:		
Washington	4	15-27	(Continued)		
			Virginia	1	15
Sept. 23, 1920-Jan. 5, 1921:			Washington	4	5-20
Illinois	1	14	New York	1	8
Maryland	1	7	Total	13	
Oregon	1	1			

Grand total..... 13
Total number of cars inspected..... 3384

Bitter pit (Stippen, Baldwin spot)- non-parasitic

This disease is becoming more generally recognized by pathologists in its many manifestations and variable characters on different varieties. It seems to be quite generally distributed over the United States but is most prevalent in the East, especially in New York, and the Northwest.

New York - Much less than usual; not important this season. New Jersey - Very abundant, especially on Baldwins. Tennessee - Unimportant. Observed on many varieties in the market, especially Baldwins, Pippins and Yellow Newtons. Maryland - More than usual. Arkansas - Severe in some Grimes orchards. Ohio - More than usual. Weather favorable for large fruit which was responsible for condition. Indiana - On Stark, Grimes and Baldwin. Washington - About same as average year. Five percent loss to crop. Everett district, mostly on Baldwin, King and Spitzenberg; Yakima district, Grimes and Black Twig; Prosser district, Gano and Ben Davis. Idaho - Less than last year. Not common.

Table 19. Losses from bitter pit (non-parasitic), as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
Jan. 13 - Apr. 26			
California	3	3	
Massachusetts	1	17.	Associated with other blemishes.
New York	3	5-13	
Oregon	2	3-20	
Washington	9	3-25	
Total	18		

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay.
July 28 - Jan. 3, 1921			
California	1	14	
Maryland	1	15	Mostly blue mold rot.
New Hampshire	3	6-20	
New York	3	5-12	
Tennessee	1	12	
Virginia	1	82	Associated with storage scald.
Washington	5	2-5	
West Virginia	1	12	
Total	16		

Grand total..... 34
Total number of cars inspected.....3384

D. F. Fisher, Wenatchee, Washington, writes as follows on bitter pit:

"Losses were greater than for several years past, especially in cases of light crops of Black Ben Davis, some orchards running as high as 75% to 90% culls on account of bitter pit."

Water core (non-parasitic)

The following note on this disease was received from Dr. Charles Brooks and D. F. Fisher, of the Department of Agriculture:

"The losses from this disease were greater than usual - Jonathan, Stayman, Rome and Winesap being the principal varieties affected. Probably 75% of the Winesaps were affected. Most of the water core was of the 'invisible' type, not extending to the surface, and hence could not be excluded from market fruit under the state law. This caused some apprehension in the trade but did not prove to be a serious matter in the case of the Winesaps, which constitute the bulk of the storage fruit. The water-cored condition disappeared from the Winesaps after a few weeks in storage, in most cases, and there was no ill effect upon the keeping quality of such fruit. But in the case of the softer textured apples, such as the Jonathan and Rome, water core did not disappear or abate in severity during storage, but instead predisposed the fruit to 'internal breakdown'. The latter condition was therefore abnormally prevalent on these varieties, and was frequently complained of as 'the apples turning black or brown inside'. Both water core and internal breakdown were especially prevalent on the larger sized apples."

Reports of water core have been received from New Jersey - Rare; Ohio - General; Wisconsin - Minor, except on Northwestern Greenings, which are quite susceptible; and Washington.

Internal breakdown (non-parasitic)

D. H. Rose in the Division Letter Bureau of Markets, 23: 8. Jan. 20, 1921, writes:

> "Internal browning and mealiness of apples has been quite common during the present shipping season, especially in Northwesterns, Jonathans, and Stayman Winesaps. In many cases it has been so bad as to look more like freezing than like the condition known to inspectors as internal breakdown. In a lot of Jonathans examined by Dr. Garrick and the writer in October, before there was any possibility of freezing in the orchards or in transit, most of the symptoms of freezing were found, except deep browning under bruises. It was noted, however, that many of the apples looked sound from the outside, but, on cutting, were found to have a quarter inch ring of apparently sound flesh outside of a browned, mealy interior.
>
> "In connection with this disease Charles Brooks makes the following statement: 'I understand that there has been an unusual amount of water core this year, particularly on Winesap. If the Jonathans were originally affected with this trouble, it is possible that there might be after effects, similar to what you describe.' This fits in well with observations made in Chicago and other markets, that, in Jonathans, internal breakdown and water core are often associated."

Idaho (Hungerford) reported much more of this trouble in 1920 than was observed in 1919. He describes it as a "breakdown of the fruit at picking time or soon after. Over-irrigation seems to increase the injury. Jonathan and Winesap especially susceptible to injury." The trouble is also reported from Ohio.

D. F. Fisher reported as follows concerning this condition in the Northwest:

> "While other factors may be involved and the influence of a previous water-cored condition has been pointed out, the most important single factor causing internal breakdown was undoubtedly the over-maturity of the apples when picked. The fall of 1920 was unusually cloudy and rainy for this 'dry climate', and coloring of the apples was slow. Hence, there was a general tendency for growers to delay picking as long as possible, waiting for color that would put a higher percent of the fruit in the Extra Fancy market grade. The crop of Jonathans and Romes was quite uneven and generally light. The size of the apples, therefore, was large, many overgrown specimens being produced under these conditions. Such apples are recognized as inherently of poor keeping quality. When picking was delayed these apples were in no condition to withstand storage since they were already soft and at the eating stage in many cases. A large proportion, therefore, reached the end of their storage life and were destroyed by internal breakdown within as short time as from three to four weeks."

Scald (non-parasitic)

Scald, being primarily a storage and market trouble, was not reported by the majority of the state collaborators. The following note was received from Dr. Charles Brooks concerning this condition:

> "Apple scald is causing an unusual amount of loss this year; the severity of the trouble apparently being due to the fact that the apples were unusually warm when they went into storage and have in many cases been held rather beyond their season."

The loss from scald as determined by the inspectors of the Bureau of Markets is given in the following table.

Table 20. Losses from scald (non-parasitic), as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of scald: No. cars	Percentage of scald: Percent	Remarks as to seriousness of scald
Jan. 10 - June 11, 1920			
California	7	5-20	
Idaho	2	55-78	
	6	7-27	
Illinois	2	13-40	
Maine	1	55	Bad scald.
	2	2-18	
Maryland	1	65	Bad scald.
	1	5	
Massachusetts	1	25	
Missouri	1	2	
New York	1	100	Covering 1/5 to 3/4 of surface.
	5	14-50	Some bad scald.
Oregon	7	25-53	Some severe scald.
	54	2-23	
Pennsylvania	3	50-70	Severe scald.
	2	3-20	
Virginia	8	55-100	Various degrees of severity.
	19	5-43	" " " "
Washington	20	50-100	" " " "
	52	25-48	" " " "
	247	2-23	" " " "
West Virginia	2	50-85	Slight to severe.
	5	12-35	
Canada	2	8-18	
Unknown	23	15-27	
Total	454		
Sept. 30, 1920 - Jan. 5, 1921			
California	1	1	
Oregon	1	75	
Virginia	1	23	Slight scald.

Origin of shipment	Percentage of scald		Remarks as to seriousness of scald.
	No. cars:	Percent:	
Sept. 30, 1920 - Jan. 5, 1921 (Continued)			
Washington	3	5-17	Mostly slight scald.
West Virginia	1	40	Mostly severe.

Grand total..... 461
Total number of cars inspected... 3462

Winter injury, killing or injury of trees by low temperature.

The most severe winter injury in the history of the fruit industry of the Northwest occurred in Idaho, Washington and Oregon last year when very low temperatures were reached during December 1919. Many trees were killed and whole orchards succumbed in some cases. All gradations of injury from total death of trees to slight cankering and loss of fruit, occurred. The following special reports of C. W. Hungerford and D. F. Fisher give an idea of the extent of the injury:

"The temperatures during December 1919 were the lowest ever recorded for many of the fruit producing sections of the Northwest. At Lewiston, Idaho, where the temperature reached 27° below zero, there was very serious injury to cherries, peaches, walnuts, chestnuts, apricots and apples. The peach and apricot crop for this year was practically a failure. The cherry crop reduced about 50% and many of the trees injured beyond recovery. The walnut and chestnut trees were killed back to within a few feet of the ground and very serious injury resulted to many apple orchards.

"In one orchard of Yellow Newtown apple trees about six acres of trees were practically destroyed. The bark on the southwest side of nearly all of the trees was dead and blistered when they were inspected May 13, 1920. The bark on the other side of the trees was a normal green color and apparently uninjured. The majority of the trees started growth on the main trunk but very few on the branches.

"In this orchard the influence of lack of sufficient irrigating water during the growing season upon the susceptibility of the trees to injury was very clearly shown. An irrigation flume ran along one side and through the middle of the orchard. All of the trees adjacent to this flume were uninjured." -- C. W. Hungerford, Moscow, Idaho.

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"The severe freezing weather of the early part of December, 1919, caused heavy loss through the killing or damage of large numbers of fruit and nut trees all over the Pacific Northwest, but more particularly west of the Cascade Mountains. The Wenatchee-North Central Washington

district, the most important apple-growing section, escaped with little or no damage, although the minimum temperature reached 20°F. This freedom from injury is doubtless attributable to the thoroughly dormant condition of the trees at the time of the freeze. The Yakima Valley, with more diversified fruit interests, suffered heavy damage through the killing of large acreages of peach trees and the loss of the crop over a larger area where the trees themselves were not killed. In parts of this district the minimum temperature reached 36°F, and here damage was experienced on all fruit trees. Winesap and Wagener apples suffered severely, some trees being killed, while the crop was materially shortened by the failure of the apples to attain normal size, due to a diminished vitality of the trees. Cherry (sweet) trees were badly damaged and the crop was generally lost. In the Walla Walla district Italian prune trees were severely affected.

"In the Hood River Valley (Oregon) apples and pears suffered severely but the pears have shown a greater recuperative power than the apples. At the time of the freeze Anjou pears were recognized as having suffered little damage, but Bosc, Clairgeau, Comice and Bartlett were seriously injured, and in many cases trees were believed to be dead which have since recovered. The crop was not damaged on the Anjous but on other varieties a few fruits only were borne on terminals in the tops of the trees. Of the apple varieties the Yellow Newtown appeared to be most susceptible to injury, while the Ortley and Red Cheek Pippin were markedly resistant. Few Winesaps are grown in this district. The injury appeared to be confined mostly to the lower areas of the district and on the trees was most severe at the snow line, diminishing in severity upwards.

"Farther west, in the non-irrigated districts of both Oregon and Washington, the damage was greatest on low bottom lands, where minimum temperatures as low as 24°F were recorded. This extreme was many degrees lower than any recorded since the coming of the white settlers to this section. Heaviest damage occurred through the killing of orchards of walnuts, apples, prunes and peaches, the trees being killed to the snow line. All fruits suffered severely upon the low bottom land where they had not reached a stage of dormancy sufficient to withstand the cold. Temperatures considerably below zero were recorded in the orchard sections at higher elevations, but due to better air drainage, and especially to the fact that the preceding summer was very dry and these trees therefore went into winter thoroughly dormant, very little injury occurred here. The orchards on the low bottom land, on the other hand, had not suffered such severe drought and had been maintained in a vigorous growing condition by intensive tillage. With the coming of the heavy rains the trees on low land were maintained in a

succulent condition that was absent from the hill orchards. These rains, combined with mild temperatures, continued almost until the freeze so the trees were afforded no chance to develop dormancy. Fortunately, a large percent of the total fruit acreage is located on the higher lands, where severe injury did not occur. The type of injury occurring most frequently in the hill orchards was 'winter sunscald' on the south side of the bodies above the snow line, but in the bottom land orchards cambium injury frequently girdled the trees at the snow line, diminishing in severity toward the top of the trees. In general the fruiting wood was not injured, or but slightly so, and frequently the buds were not damaged, especially on prunes and apples. In the case of most varieties of cherries, pears and peaches, however, the fruit buds were killed. The Royal Ann cherry and Anjou pear produced a fair crop and generally appeared more hardy than other varieties. Bartlett pears produced a few fruits on terminal growth high up in the trees.

"The influence of vitality in withstanding the damage was strikingly demonstrated in many cases. Old, devitalized Italian prune trees failed to survive the season but vigorous young trees growing alongside regained full vegetative vigor and matured a full crop. Trees that had been well fertilized (not over-stimulated) were only slightly injured while unfertilized trees adjacent were killed. Trees that had been prematurely defoliated through spray injury the previous season were killed, while those not subjected to such injury came through.

"The snow-blanket on the ground varied in depth from 10" to 36" and this precluded any root injury. This also gave a chance to renew the tops of the trees killed to the snow line by stump grafting or from shoots from adventitious buds below. This is being done with special promise in the case of walnuts and some apples. Trained-up Loganberry and other vines were killed to the snow line and the crop was reduced 40-50% thereby. Nor was the damage confined to fruits for ornamentals; oaks, and other forest trees were badly damaged or killed." -- D. F. Fisher, Wenatchee, Washington.

Washington (Heald and Dana)- The highest amount of injury ever known in some sections, resulting in die back and reduced vitality with lower yield. The important apple sections report 12-30% of all apple wood killed. Due to early December (1919) temperatures (29-31° below zero).

Oregon (Barss)- The below zero temperatures of last December caused the death of some apple trees, especially Baldwins in low situations in the Willamette Valley. Newtowns were also severely damaged. Many orchards of different varieties were seriously affected and in some cases will be pulled up. The great majority of orchards, however, will pull through with little permanent evidences of injury and a good crop is anticipated this fall in many sections. In general, hill orchards escaped serious damage.

The accompanying map with a table showing the temperatures in some of the principal fruit sections of the Northwest is presented to show the extent of the disastrous freeze of 1919-20.

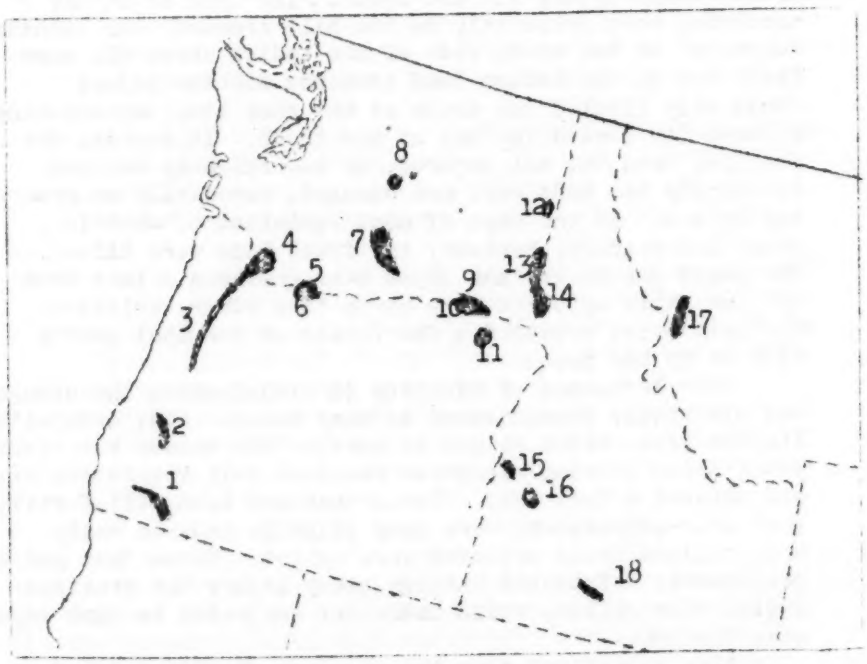

Fig. 12. The principal fruit areas of the Northwest.

Table 21. Minimum temperatures in the principal fruit areas of the Northwest.

Fruit section	Minimum temperature December, 1919.
1. Rogue River Valley	-10 to -15
2. Umpqua Valley	0 to 2
3. Willamette Valley	-6 to -22
4. Vancouver (Clark County)	-10 to -15
5. White Salmon	-14
6. Hood River	-10 to -15
7. Yakima Valley	-24 to -36
8. Wenatchee Valley	-12 to -20
9. 10. Walla Walla Valley	-14 to -36
11. Grande Ronde Valley	-22 to -24
12. Spokane	-15 to -25
13. Palouse-Pullman	-24 to -25
14. Lewiston-Clarkston	-23 to -27
15. Payette	-26
16. Boise	-14 to -16
17. Bitter Root Valley	-25
18. Twin Falls	-8 to -15

No serious general injury was reported from the eastern half of the country, due to the fact that no extremely low temperatures were reached.

The following reports are from the collaborators of these sections:

New Hampshire (Butler)- No trees killed but considerable injury to individual limbs, Baldwins being especially affected.

Connecticut (Haskell and Stoddard)- Cases of collar injury were noted on the southwest side of about seventy-five apple trees of the variety Opalescent. In many cases the bark was loosened half around the tree. Healing was going on, but poorly. In the same orchard alternate rows of another variety, Williams, were unaffected.

New York (Chupp)- A slight amount both in the Hudson and Lake Ontario fruit district. Not important.

New Jersey (Cook) Winter injury common.

Ohio (Selby)- Winter injury has occurred as a result of ice coating, low temperatures and delayed maturity of apple trees; it has been found in poorly drained locations, and, while less than on cherry and plum trees, has been more than normally serious.

Frost injury - killing of blossoms.

Frost and freezing temperatures were recorded for the entire northern Mississippi Valley and Ohio Valley and northward on May 14 and 15. This cold spell extended eastward, including West Virginia, Pennsylvania, and parts of Maryland and Virginia. Fortunately the season throughout the entire northern United States was about two weeks late and little damage was done north of the 41st parallel. In central Illinois, Indiana and Ohio, however, the apples were in full bloom at this time. It was thought at the time that this would result in an almost complete killing of the fruit. This proved to be true in the case of some varieties but others seem to have escaped with very little injury. In a number of commercial orchards, however, the crop was so reduced as to make harvesting unprofitable. While considerable local damage resulted, sufficient fruit escaped to make the total damage rather low. A heavy yield of those varieties which escaped the frost reduced the loss to many commercial growers who had a number of varieties. An earlier cold spell, resulting in freezing temperatures on April 5, did some damage to apples in Arkansas, Tennessee, Kentucky and southern Illinois and Missouri. The damage to apples, however, was slight as compared to that done to earlier fruit crops such as peaches, plums and cherries.

Frost injury of fruit and leaves.

Russet bands as a result of early frosts were reported from Virginia, Ohio, Indiana and Illinois.

Selby in Ohio reported: Curious manifestations of freezing injury have been noted in Ross and Athens Counties and doubtless occur elsewhere. Along with serious loss from freezing have come clusters of dwarfed leaves with delayed formation of buds, and scattered fruits having one side scarred. Variable injury is noted on different branches of the same tree. Frost rings upon apple are observed in these districts as in most others.

Hail injury

Indiana (Gardner)- Very severe throughout state.

New York (Chupp)- Hail injury reported as serious in Orange County.

Illinois (Anderson)- Hail injured some apples but did more damage to peaches in the region about Cobden, Union County.

Idaho (Hungerford)- Considerable loss in the Lewiston orchards.

Storage rots of apples

Dr. Charles Brooks writes concerning storage rots in general for 1920:

> "More than the average amount of rot has developed on stored fruit. This condition may be partly due to the fact that the warm weather during picking season made it unusually difficult to secure prompt cooling of the fruit after it went into storage."

Miscellaneous fruit rots and spots

Alternaria rot, caused by Alternaria sp., is mentioned by Cook in New Jersey as frequently following blossom end injury (blossom end rot) caused by arsenicals. Core rot due to Alternaria was mentioned by Hungerford as causing serious trouble in Idaho; in some varieties the entire apple rots on the tree. This type of the disease was also reported from Washington and was commonly observed in Illinois.

Phytophthora rot, caused by Phytophthora cactorum (Lebert & Cohn) Schr., was reported by Clinton as occurring in stored McIntosh apples in Connecticut.

Jonathan freckle (non-parasitic) was reported from Washington by Heald and Dana. "Distinct from Jonathan spot; entirely superficial." Brooks believes this to be caused by the same conditions which bring about Jonathan spot.

Spot necrosis is reported from Washington. The possible cause and the nature of the injury are not given.

Spongy dry rot, caused by Volutella fructi Stev. & Hall, was reported as causing considerable rot in storage in Massachusetts. It was found on a number of apples in the local markets in Illinois. The apples were said to be from Canada but their origin was doubtful.

Miscellaneous bark cankers

Brown bark spot (Heald and Dana) Washington - This disease kills trees and produces a die-back.

Rough bark (cause unknown)- Reported by Heald and Dana from Yakima County Washington and from Coeur d'Alene, Idaho.

Cytospora canker and Valsa die-back. Chupp in New York stated Cytospora was reported once as a twig canker following some other weakening factor. Selby in Ohio stated that Valsa die-back due to Valsa leucostoma (Pers.) Fr. was observed in Mercer County. New Mexico (Leonian) reported Cytospora leucostoma

weakened trees. It is getting quite abundant in the state. Healthy trees are not affected as a number of inoculations have shown. Ohio Valley (Anderson)- "I have observed a Cytospora on injured or weakened or dead twigs and branches of apple trees throughout the Ohio Valley. It is very common everywhere. The perfect stage is a Valsa which I have referred to Valsa ambiens Fr., but with some question as to the correctness of my determination". Arizona (J. G. Brown)- Reported die-back due to Cytospora rubescens from Apache County. Minnesota also reported canker as due to Cytospora.

Plenodomus canker (Plenodomus fuscomaculans). One report from Michigan.

Measles (Cause unknown)- Was reported from New Mexico. (Leonian)- This is getting to be quite a serious apple trouble throughout the state". See Supplement 9 for further data on this disease.

Spray injury

The usual amount of spray injury was reported in 1920 and few points of interest were mentioned. New Jersey reported spray injury common. Tennessee reported that "lead injury" was important on susceptible varieties, causing calyx end injury on Ben Davis and Delicious, often followed by black rot. "Lime sulfur injury" in this state caused "leaf injury, marginal and tip, slight on fruit (Ben Davis and Delicious). In one case where found, I think was due to use of spray gun with low pressure, and resultant overdrenching"-- Hesler. Ohio (Selby)- Reported arsenical and "spray gun injury". Illinois (Anderson)- Reported serious injury to the foliage in many orchards due to the fact that the spray was applied after the primary scab infection (which was very heavy), resulting in burning over and around the infected spots. In some experimental blocks serious leaf burning resulted from the application of magnesium arsenate. Lead arsenate caused considerable blossom-end injury, especially on undernourished Ben Davis trees. Bordeaux injury was evident in many orchards in southern Illinois where early applications were made in an attempt to control blotch. Michigan (Coons)- Reported spray burn where magnesium arsenate Bordeaux was used; also some lime sulfur russeting. Minnesota reported local spray injury. Idaho (Hungerford)- "Serious injury noted this year upon Baldwin trees sprayed with Scalecide spray late in November 1919. All trees in one orchard were killed." Washington reported lime sulfur sun scald.

Collar rot (causes not definitely determined)

Ohio (Selby)- Cause freezing and subsequent infection. Especially so on Grimes and Baldwin; serious losses in South.

Illinois (Anderson)- Cause unknown, probably winter injury. Primarily a Grimes trouble but occurs on other varieties. Loss to crop for state 1% annually.

Washington (Heald and Dana)- Non-parasitic. Very serious in Okanogan and Yakima Valleys. Mostly on Winesap and Spitzenberg.

The following report has been received from C. W. Hauck, Yakima, Washington:

> "Our most serious problem is collar rot. It is creating great havoc in our orchards and every year we lose quite a

number of trees. During the past season this trouble appeared to be getting worse and one of our most frequent questions is 'What shall we recommend as a remedy or a preventative?'"

Bastard toad flax on apple roots.

This parasitic flowering plant (Comandra pallida A. DC.) was found by D. F. Fisher at Wenatchee on apple roots. The wide range of this plant in the Northwest would indicate that it might prove of some importance as a parasite. The amount of injury to the host is problematical.

PEAR

Blight caused by Bacillus amylovorus (Burr.) Trevisan

Blight was reported from most of the states where pears are grown. It was not as serious in some sections as in 1919, but was reported as worse in most of the Southern States, in Connecticut, New York, Indiana and Ohio. The percentage loss to the crop was generally quite large and an average of 10% would be conservative. East of the Rocky Mountains the pear crop was estimated at 10,000,000 bushels in 1920. The loss from blight in this section would probably reach 1,000,000 bushels this season.

Massachusetts (Osmun)- About the usual amount.

Connecticut (Clinton)- More than usual and more than last year, 5-10% loss.

New York, producing 2,375,000 or about one-fourth of the 1920 crop east of the Rockies, reported a loss of 10-20%. It was worse in this state than last year. The first observation was made on May 27 in Nassau County.

New Jersey (Cook)- Common but less severe than usual.

Pennsylvania (Thurston and Orton)- Less than last year and much less than the average year. Less than in our history of the disease in Pennsylvania.

Virginia (Fromme)- Especially severe this year in the southwestern part of the state.

West Virginia (Sheldon)- A number of trees near Morgantown were much injured.

Kentucky (Valleau)- All pear trees observed badly blighted.

Tennessee (Hesler)- It is commonly taken for granted that blight

has driven the commercial pear out of the state during the last several years. The disease was severe this year wherever the pear is found.

Georgia (McClintock)- Limiting factor in pear production. Loss of 50% this year. Some varieties show resistance. (Roberts)- Between Macon and Atlanta practically all the new growth on all trees in the section killed by blight. (Observations made April 27, 1920).

Arkansas (Elliott)- More severe than usual, 100% of crop injured. First observed in April.

Ohio (Selby)- More than usual but small percent of the crop injured.

Indiana (Gardner)- Worse than last year and more than average.

Illinois (Anderson)- Severe locally but not much blossom blight, thus assuring a fairly good crop. Weather not generally favorable for disease later in season.

Michigan (Coons)- Epidemic which began early checked by hot weather and loss not much greater than average.

Missouri (Hopkins)- Moderate.

New Mexico (Leonian)- Slight, in spite of the fact that it was very severe the past year and many of the old cankers were left upon the trees and still active during the present season.

Arizona (Brown)- Five percent loss from blight.

No reports were received concerning blight in the Great Plains region. There are, however, comparatively few pears grown in this region.

In the Northwest blight was not an important factor during 1920 according to reports received. This is no doubt due to the rigid inspection of orchards in that region and the cutting out of the disease when it first appears. Hungerford in Idaho reports the disease as serious only in neglected orchards. Growers in general are succeeding in keeping it out of their orchards.

In Oregon Barss reported the disease worse than usual and stated that the damage was large in Jackson County. It was general in the irrigated sections except Hood River where it was rare, if present at all.

In California according to J. P. Benson the disease was quite severe in Fresno County. Pears are not grown on a commercial scale there, however.

It is hoped that before many years varieties of pears may be secured which are resistant to blight and leaf spot (Fabraea maculata) and, at the same time, possessing desirable market qualities. This work is being actively pushed by the Oregon Experiment Station through Mr. F. C. Reimer of Talent, Oregon, and by the United States Department of Agriculture through Dr. B. T. Galloway, Office of Foreign Seed and Plant Introduction. A recent summary of this line of investigation by Dr. Galloway appeared in the Journal of Heredity 11: 25-32, 1920. Resistant stock material has already been obtained by the introduction of several oriental species, Pyrus ussuriensis, P. betulaefolia.

and P. calleryana. Of these the last appears to be one of the most promising as a stock on account of its resistance to both blight and leaf spot, and its congeniality to our common varieties when grafted or budded on it. Concerning this Dr. Galloway writes:

> "It is a vigorous grower under all conditions. It holds its leaves well, and it can be budded any time from July 1 to September 1. All of our best kinds of pears so far tried take well upon it. The seedlings are easily grown and, when from pure types, run remarkably uniform."

While it is desired to secure resistant stock upon which to work our commercial pears, in order to reduce the chances of body and collar blight, it is still more desirable and essential to secure tops which are blight resistant. Dr. Galloway has kindly given us information concerning work along this line at Chico, California, where a large number of oriental pears introduced by the Office of Foreign Seed and Plant Introduction are being tested. He states that several varieties are now fruiting which are blight resistant and, at the same time, are equal to some of our best pears as far as quality of the fruit is concerned. These varieties are of oriental origin. It is hoped that budwood from these may soon be available for general introduction.

The only measures which were used to control blight during 1920 were cutting out the blighted twigs as they appeared and the use of resistant varieties. Selby in Ohio stated that "It is to be noted that where precautions have been taken to remove blighted twigs the early part of the season, very little loss has been experienced". McClintock in Georgia reported that "One Japanese sand pear and some of the hybrid pears supplied by Dr. Waite have shown marked resistance this season at the Station". The Bosc pears were reported most affected in the Rogue River Valley, Oregon.

The following note on pear blight control has been furnished by C. C. Cate:

> "Pear blight has been a serious disease in the Rogue River Valley since 1907. The first campaign on control was only partially successful, since in the cutting out practices mercuric chloride was used and attention was given to infections on aerial parts only. These failures led the writer to make thorough root and crown inspection a part of the regular program, and many cases of root and crown blight were discovered. In further work it was demonstrated that those sections in which careful root and crown inspection was carried out andall such cases of blight treated or cut out remained freest of blight. Early in the work the ineffectiveness of mercuric chloride in sterilizing wounds was suspected, other agents were tried and among them lysol and mercuric cyanide. The latter has since been shown by Professor Reimer to be very effective as a blight disinfectant when used on wood. As an additional means of assisting in the control of blight a combination spray of nicotine, oil emulsion and arsenate of lead was used to combat the insects which might be acting as carriers, the most important of which seemed to be thrips. The careful cutting out with attention to root and crown infections, the

discarding of mercuric chloride as a disinfectant, and the spraying program outlined have given good results in the control of blight in the Rogue River Valley."

Pear scab caused by Venturia pyrina Aderh.

This disease seems to be of little importance in most sections of the country since few reports have been received. It seems to cause most damage in the New England States. New Hampshire (Butler) reported considerable damage to the fruit. In Massachusetts it was important in 1920 on some varieties and caused about the same loss as last year. Connecticut (Clinton) reported it more prevalent than during the average year. It is reported on Flemish Beauty. New York (Chupp) had less scab than last year and it was important only in isolated cases. The first report was on June 7 from Orleans County. In Dutchess County several Flemish Beauty trees were severely affected. In New Jersey the disease was common but easily controlled by spraying. Pennsylvania reported almost no loss in sprayed orchards and probably less scab generally than usual. It was observed on twigs. In Ohio the disease was relatively more prevalent than in 1919. It was reported as present but not important in Michigan and Illinois. Washington (Heald and Dana) reported it as general west of the Cascades. Oregon (Larss) reported it as general in western Oregon, particularly in the Willamette Valley. First observed April 16 at Cottage Grove. Spraying usually successful if early sprays are timed right.

Table 22. Losses from scab caused by Venturia pyrina, as shown by examination of cars at destination by inspectors of the Bureau of Markets

Origin of shipment	Percentage of decay: No. cars	Percent	Remarks as to seriousness of decay
Delaware	2	76	Very badly scabbed.
Maryland	1	23	Spotting 1/3 to 1/2 surface.
Michigan	1	3	Affected slightly.
New York	1	25	
Total	5		
Total number of cars inspected	477		

Leaf spot caused by Fabraea maculata (Lev.) Atk.

This leaf spot was reported from New Jersey as less than usual, being most severe in the southern half of the state. In West Virginia Sheldon reported it as occurring on some very old and very large trees in the neighborhood of Morgantown, especially on sprouts and suckers. In Tennessee Hesler reported heavily infected fruit in the market which was said to have come from Delaware. Near Bloomington, Illinois, the disease was observed in a nursery, causing some damage to the foliage of the nursery stock. It was also noticed on some large pear trees at Normal, Illinois.

Leaf spot caused by Mycosphaerella sentina (Fr.) Schrot. (Septoria pyricola Desm.).

This leaf spot was reported from New York as rather generally prevalent, but causing no great damage. In Albany County it was very prevalent; most serious on Seckel, some of which were almost completely defoliated. It was first observed in Albany County on June 21. New Jersey reported it of little importance this year. Hesler in Tennessee also regarded it as unimportant this season. In Ohio Selby stated that it caused quite serious defoliation in one orchard observed. It was regarded as more prevalent than usual but causing no great loss. It was present in limited amounts in southern Illinois.

Black rot caused by Physalospora cydoniae Arnaud.

Black rot of pear was reported by the collaborators from only three states. It was reported as locally severe in Indiana, while in Ohio it was less prevalent than usual. In Illinois it caused a great deal of damage in the southern end of the state where it is always serious on fruit that has not been properly sprayed. The cankers caused by this fungus are more common on pear than on apple and the blight cankers are often covered with the black rot pycnidia. This may explain in part its more general prevalence on pear than on apple.

The reports of the market inspectors indicate the importance of this disease.

Table 23. Losses from black rot caused by Physalospora cydoniae, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
Colorado	1	2	
Delaware	7	10-47	All stages of decay.
Illinois	1	14	Early stage of decay.
Indiana	1	42	
Kentucky	2	27-35	
Maryland	6	20-55	Other decays also present, mostly blue and brown rots.
Michigan	7	4-35	Associated with blue mold, brown rot, and Rhizopus rot.
Missouri	1	53	Mostly advanced stage.
New York	20	2-37	Considerable blue mold and Rhizopus rot.
West Virginia	1	6	Associated with blue mold rot.
Unknown origin	6	5-37	Some Rhizopus rot present.
Total			53
Total number of cars inspected			477

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Townsend. reported from Medina County, Ohio, Oregon and Washington. Hairy root was also reported from Washington.

Blossom blight caused by Monilia sp. (not Sclerotinia cinerea) reported from Oregon by Barss causing a spur blight at blossom time.

Incense cedar rust caused by Gymnosporangium libocedri was reported as causing very slight damage in western Oregon. First observed this year May 26 at Mystal Creek.

Brown bark spot, cause not given, reported from Washington. "Most severe case ever reported" (Heald and Dana).

Rough bark disease, cause unknown, reported from Washington.

Brown blotch, cause not given, was reported from New Jersey. "Easily controlled by spraying". (Cook)

Scaliness, cause unknown, reported from Michigan.

Rot, caused by Botrytis sp. was reported from Washington.

Bark canker caused by Myxosporium corticolum Edgerton was reported from Michigan.

Cracking of fruit probably due to weather conditions was reported from New York. (Chupp)- "Observed near Geneva; considerable loss in orchards. Specimen sent from Nassau County; reported from Columbia County. The cracking occurred in the absence of scab and other diseases." Cracking of apple fruit is common in Illinois some seasons when heavy rains follow a long dry period (Anderson).

Texas root rot caused by Ozonium omnivorum Shear was reported as serious in Texas where cotton dies.

Sooty blotch caused by Leptothyrium pomi (Mont. & Fr.) Sacc. was reported from only one state, Indiana, where the loss was given as negligible.

Black end caused by drought or excessive transpiration was more prevalent than usual in Oregon in the hotter sections of the state and on soils that dry out badly. Blackening of blossom end. Bartlett especially susceptible.

Blue mold rot caused by Penicillium expansum (Lk.) Emend. Thom. was found by the Bureau of Markets inspectors to be present on pears shipped from eleven states. It was probably the most common trouble in shipments, the percentages of decay ranging from 1% to 77%, with a general average of 10%, other decays being present.

Gray mold rot caused by Botrytis sp., was reported as occurring on pears in five cars shipped from California, New York, and Washington, decay ranging from 3% to 7%.

Brown rot caused by Sclerotinia sp., was present on pears in shipments from Delaware, Georgia, Illinois, Indiana, Maryland, Michigan, New York and Washington, the average infection for the twenty three cars inspected being very nearly 20%. This decay was in most cases associated with other rots.

Rhizopus rot caused by Rhizopus sp., was very common in shipments of pears from various parts of the country, the pears in one car from Virginia being a total loss. Other decays were present in all shipments.

Winter and frost injury to pears

Frost bands were reported by Hesler as severe in one orchard of ten acres at Humboldt, Tennessee. Frost injury was reported by Dana and Heald from two counties in Washington. In the region across central Illinois, Indiana, and Ohio, and in West Virginia and Virginia, where frost occurred

on May 14 and 15, there was more damage to pears than to apples. In Arkansas pears were damaged by the frost of April 5. This was true to a less extent in Union County, Illinois.

Winter injury was reported from Ohio and New York. The injury to pears in the Northwest, due to the very severe winter of 1919-20, was not as serious as in the case of apples. See the special report of D. F. Fisher under winter injury to apples.

QUINCE

Fire blight caused by Bacillus amylovorus (Burr.) Trevisan

This disease is the limiting factor in quince production in many sections of the country, according to past reports. In 1920 it seems to have been unusually severe in the New England States, especially Connecticut and Massachusetts, and in New York. Clinton in Connecticut stated that it was worse than last year and more than average. He estimated a 10% loss for the year. In Massachusetts Osmun also reported it much worse than usual and stated that it was very important this season. It caused much more loss in New York than in 1919 with an estimated reduction of 3-5%. New Jersey reported less damage than for last year. It is reported from West Virginia by Sheldon as occurring on the quinces in the town lots in Morgantown, where an occasional diseased tree was found. Ohio reported more than usual, with a loss of 5-50%. There were three reports of the disease in Indiana. It was also reported from Texas, Illinois and Michigan.

Leaf spot caused by Fabraea maculata (Lev.) Atk.

This disease was reported from New Jersey, Ohio and Tennessee as occasional and of little importance. In Georgia, McClintock stated that it was more serious than last year and more than average, and that it was serious on nursery stock and in gardens causing premature defoliation. It was observed in two localities in Illinois, where it caused serious injury to foliage. At Lilly it has caused complete defoliation of a large quince orchard for four successive years, the leaves being nearly all off by the first of August. Ordinary sprays applied, according to the spray schedules of other stations, have failed to control this disease.

Quince rust caused by Gymnosporangium germinale (Schw.) Kern. (Gymnosporangium clavipes Cooke & Peck.)

This disease was reported as very common and important in Massachusetts. The loss was about as usual. Two reports were received from Connecticut, and it was reported as very common and destructive in Virginia. It is also reported from Michigan. This rust seems to be prevalent and destructive wherever the quince is grown in the neighborhood of the red cedar.

Other diseases.

Black rot caused by Physalospora cydoniae Arnaud, was reported from New Jersey and Ohio.

Bitter rot caused by Glomerella cingulata (Stoneman) Sp. & Von S., was reported from Lancaster County, Pennsylvania.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt was reported from New York. (Chupp)- "A canning and preserving company of Rochester sent specimens of their stored quinces which were covered with the brown rot organism. The manager stated that a large percentage of their quince supply was rotting in this manner."

DISEASES OF STONE FRUITS

PEACH

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

The distribution of brown rot coincides with the geographic range of the host. As usual, it was far more destructive in the Southern States than elsewhere. In the North Atlantic States, including Delaware and Maryland, the blossom blight was even worse than in 1919, when it was epiphytotic. The fruit rot was not so important throughout this region. In the Gulf States and North and South Carolina there was an enormous loss from brown rot which, in most cases, was associated with curculio. North of the Ohio River the loss was very low, as was the case in 1919. In Tennessee and Kentucky there was some blossom blight and a fairly heavy loss from fruit rot. In New York the loss was very much less than in 1919. The Northwest had practically no loss from brown rot but California, which produced about a third of the total peach crop of the United States in 1920, had more brown rot, both as blossom blight and fruit rot, than usual.

The percentage loss for the different states is shown in the accompanying map. Attention must be called to the fact that curculio injury is so closely associated with brown rot that it is difficult to place a correct valuation on the relative importance of these two factors.

The following summaries from the reports of the state collaborators indicate the nature of injury and the severity of the disease:

Massachusetts and Connecticut reported traces of the disease as blossom and twig blight, but almost all the blossoms were killed in these states by an early freeze. New York (Chupp) reported a heavier loss than usual from blossom blight but much less fruit rot than last year. The blossom blight did not materially affect the yield. In New Jersey Cook reported blossom blight as severe but less than in 1919. Haskell stated that many orchards in southern New Jersey showed from 20-30% blossom blight, with small cankers developing on the twigs. Fruit rot was not especially severe. Pennsylvania suffered a heavy loss both through blossom blight and rotting of the fruit.

Fig. 13. Estimated percentage loss from brown rot of peach, 1920.

McCubbin reported as high as 62% of blossoms killed by blight in some orchards in southeastern Pennsylvania. Delaware, according to Manns, also suffered from blossom blight and many cankers were observed on the twigs. Rains late in the season caused considerable fruit infection. Maryland had more brown rot than usual, causing considerable blossom twig blight. In Virginia blossom blight did not cause nearly as much loss as in the northern states according to Fromme. Fruit rot was only moderately severe. Giddings stated that the loss in West Virginia consisted mostly in the rotting of fruit which was rather bad and worse than last year. North Carolina suffered more from fruit rot than from blossom blight. The most severe losses from any state were reported from Georgia, where the curculio was very destructive and thus increased the loss from brown rot on the fruit. In many parts of the state 50% of the crop was lost. There was also some damage from twig blight. Mississippi, according to Neal, had more brown rot than usual and twig and blossom blight were prevalent. The Arkansas peach crop was almost an entire failure on account of the April freeze. This was also true of Oklahoma and Kansas, where the buds were far enough advanced to be injured. Little brown rot developed in this section on the few peaches left. Valleau in Kentucky reported some blossom blight with little rot on early fruit but severe losses from rot on the late varieties on account of rainy weather. Twig blight was very severe in Tennessee according to Hesler. In some orchards 75% of the twigs were affected. There was also some blossom blight and

moderate fruit rotting. Indiana and Illinois both reported very little loss from brown rot. This was due to the dry weather during ripening and picking time in most sections. Ohio suffered some loss, more than in 1919, according to Selby. In Ottawa County, Ohio, and adjoining regions, Rose reported, "It seems likely that the peach crop of this section is saved from loss due to brown rot by the relatively cool weather at picking time and the fact that much of it is marketed within the state of Ohio." California (Smith)- Reported that brown rot was worse than usual in that state and a rather serious factor in some regions. Twig and blossom blight, as well as fruit rot, caused heavy losses in Santa Clara County and the coast just below with scattered infections in the Sacramento and upper San Joaquin Valleys. There was practically no loss in Washington according to Heald.

The total loss from brown rot in the United States in 1920 is estimated at 6,199,000 bushels or 11.5% of the crop. The heaviest losses were in Georgia (2,763,000 bushels) and California (811,000 bushels). The corrected losses in each state will appear in the Plant Disease Bulletin, Supplement 18.

Control of Brown Rot.

Self-boiled lime sulfur seems to have been the most generally used spray for the control of brown rot in most states. Dusting is becoming popular in certain sections of the East but it remains to be seen whether this will prove successful against brown rot on the fruit. Atomic sulfur is used by some growers and some even advocate the use of summer strength commercial lime sulfur.

Cook in New Jersey stated that the blossom blight was held in check by the pink bud spray. Smith in California reported that the disease "was checked this year in Santa Clara County on apricots by spraying once, beginning when the scales begin to expand. The treatment was successful on precocious trees in orchards which were in full bloom when sprayed, 4-5-50 Bordeaux or lime sulfur being used." McClintock reported that "in the coastal plain of Georgia neither sprays nor dusts controlled curculio or brown rot satisfactorily". In Maryland dusting did not control brown rot as well as spraying with 8-8-50 self-boiled lime sulfur, according to Temple. Indiana reported good control with lime sulfur sprays except in Vanderburg County. In Illinois so little rot developed during the season and it was so dry as harvest time approached that growers did not apply the late summer sprays.

Relation of Weather to Brown Rot.

In those sections where blossom blight was most severe the month of April was unusually wet and cold. But this was also true in the Ohio Valley, where there was little blossom blight. Little information was given by the collaborators as to the relation of weather to the blossom and twig blight and it is desirable that this information be obtained.

The relation of fruit rot to weather conditions is well known. The heavy loss in Georgia this year is to be attributed in part to a wet summer. The very minor loss in Illinois was due, no doubt, to the fact that the summer was very dry in the peach growing sections.

Table 24. Losses from brown rot caused by Sclerotinia cinerea, as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Alabama	5	27-42	Rhizopus present in some cars.
	13	2-23	
Arkansas	1	22	
California	2	5-7	
Delaware	2	35	
	3	3-15	
Georgia	30	50-82	Considerable advanced decay.
	119	25-49	Associated with Rhizopus rot in some cars.
	448	1-23	Some Rhizopus rot present.
Idaho	1	7	
Illinois	11	5-27	Some Rhizopus rot present.
Kentucky	2	50-57	
	2	2-4	
Maryland	5	25-42	
	18	1-20	
Michigan	4	37-60	Associated with Rhizopus rot.
	16	1-25	
Missouri	2	10-12	Considerable Rhizopus present.
New Jersey	2	30-50	
	1	1	
New York	37	50-97	Well advanced and associated with Rhizopus in many cars.
	59	25-47	Considerable complete decay.
	155	1-23	Considerable Rhizopus rot present.
North Carolina	29	1-30	
Ohio	1	62	
	9	2-15	
Pennsylvania	1	50	
	5	3-12	
Tennessee	5	2-10	
Texas	1	13	
Unknown origin	1	100	Complete decay.
	7	1-17	
Virginia	3	45-74	Considerable bad decay.
	17	1-27	
West Virginia	4	58-82	
	44	1-35	
Total			1065
Total number of cars inspected			1298

Scab caused by Cladosporium carpophilum Thum.

The usual number of reports were received indicating wide distribution of scab in the eastern half of the country in 1920. No reports were received

from western states, where scab seems to be very rare. With the exception of a few states scab seems to have caused little or no injury and was generally less severe than last year. Indiana and Ohio reported more than usual. In some sections scab appeared quite late in the season and caused losses on late varieties. Taken the country over, the disease was a negligible factor in 1920. Connecticut reported less than last year and less than usual, but there was practically no peach crop on account of the freeze. New York had very little scab even on unsprayed trees. New Jersey reported a general prevalence of the disease. Pennsylvania reported less than in 1919 but 20% of the crop commercially injured. Scab was quite severe in Delaware, according to Manns. Maryland reported a 5% loss; especially bad on Salway; worse in the lower elevations. Fromme in Virginia reported a late development of scab. It was first observed at Shipman on July 15 and was very general on July 26 at Blacksburg. He estimated a 3% loss and a general distribution of the disease. West Virginia (Giddings) reported a general distribution. It was of considerable commercial importance. Valleau reported the disease as severe in Kentucky on all peaches observed. It was not regarded as of any importance in Tennessee. J. W. Roberts reported scab appearing on June 5 at Fort Valley, Georgia, and generally found on all varieties of unsprayed fruit. Very little loss resulted in Georgia according to McClintock. It was generally prevalent in Alabama and Mississippi, but not important. Ohio reported an unusually bad outbreak with an estimated loss of 10-25% of the crop. Indiana (Gardner) reported more scab than usual with a serious epiphytotic in the Vincennes peach region. Only local damage on late unsprayed varieties was noted in Illinois. The commercial crop was practically free from the disease. In Michigan scab was "common as usual". It was reported as severe in Missouri.

In most of the states it was stated that the disease was not important in the commercial orchards where spraying was practiced. The question of the dusting for peach diseases is still an open one, but very good results have been obtained in most regions in the control of scab and in some cases dusting has proved more effective than spraying. There is little doubt but that dusting will prove entirely satisfactory in the control of peach scab. In Maryland Temple reports about as good results with dust as with self-boiled lime sulfur.

Table 25. Losses from scab caused by Cladosporium carpophilum, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Origin of shipment	Percentage of decay	
	No. cars	Percent		No. cars	Percent
Illinois	1	2	Virginia	2	2-18
Kentucky	1	17	West Virginia	4	10-22
Maryland	1	65			
Total				9	
Total number of cars inspected				1298	

Leaf curl caused by Exoascus deformans (Berk.) Fckl.

Leaf curl was epiphytotic during the spring of 1920 in most of the states where peaches are grown. It was worse than in 1919 in sixteen out of twenty-one states reporting, and only two of these states reported it as less

prevalent. When it is considered that 1919 was among the worst leaf curl years, the seriousness of the situation may be realized. The ease with which this disease can be controlled, however, has made the loss in the commercial orchards of very minor importance. It is probable that, had no spraying been done for the control of leaf curl, there would have been a fifty percent loss to the peach crop of the country in 1920. The relatively small losses recorded for the different states do not, therefore, indicate the seriousness of the disease. For this reason Table 26 is given below.

Table 26. Prevalence, importance and dates of appearance of peach leaf curl as reported by collaborators, 1920.

State	Prevalence compared with: Last year	Prevalence compared with: Average year	Importance	Earliest appearance: Date	Earliest appearance: Place
Mass.	More	More			
Conn.	Same	Less	Not important.	6/21	Marbledale
N. Y.	Less	Less	Only in unsprayed orchards.	5/24	Albion
N. J.	More		Locally serious		
Pa.	More	More	Only in unsprayed orchards.	5/14	York County
Del.	More	More	In orchards unsprayed, or not sprayed in time.	5/25	
Va.	More	More	Little in commercial orchards.	5/14	Crozet
W. Va.	Same	Same	Serious in unsprayed orchards.		
Miss.	More	More		4/24	New Albany
Okla.	More	More			
Ky.	More	More	Serious		
Tenn.	More	More			
Ohio	More	More			
	Much	Much	Limiting factor.		
Ind.	More	More			
	Much	Much	Serious in unsprayed orchards.		
Ill.	More	More		5/11	Lilly
Mich.	More	More	Serious in unsprayed orchards.		
Iowa	More	More	Moderately serious.		
Mo.	More	More	Serious	5/1	Columbia
Ariz.			Unimportant		
Idaho	Less				
Ore.	Same	Same	Much damage.		
Calif.	More	More	Very serious.		

Delaware and Maryland suffered an especially severe epiphytotic, due in part to the fact that many commercial growers sprayed too late to control the disease. New York is among the few states reporting less curl than last year, but from several sources it was learned that it was locally quite severe, especially on unsprayed orchards. In New Jersey Haskell reported the disease as most serious in the southern part of the state. Pennsylvania reported more curl than usual but sprayed orchards are not seriously affected. Temple in Maryland stated that the disease was as prevalent as in 1919, even where dormant sprays were applied. Fromme reported curl as locally serious but not in commercial orchards in Virginia.

In the Georgia peach belt curl was evidently not any more severe than in 1919, but was reported by McClintock as serious in unsprayed orchards.

In the Gulf States west of Georgia the disease was severe in the northern end of the states, and appeared quite early. In the Ohio Valley the epiphytotic was the worst ever recorded. The commercial growers suffered in this region where they failed to spray and in many cases reports were received of serious damage even in sprayed orchards. Gardner stated that the disease was especially bad in Indiana and widely prevalent. "Loss of half of the crop was caused in one forty-acre orchard, because the owner failed to spray this year; the loss was due not only to defoliation but to direct attack upon the small fruits." Oregon (Barss)- Everywhere. Much damage. California (Smith) reported "a very bad attack in most districts, in spite of a dry winter, on account of heavy rains at blossoming. Many report failure of early spring spray to check it, though fall spraying, as for Coryneum, was successful for curl". Also reported from Fresno County, California, by J. P. Benson, county agent.

The total loss from leaf curl for the United States in 1920 is estimated at 1,583,000 bushels or about 3% of the crop. California suffered the most severe loss on account of the large production in that state and the unusual severity of the disease this season. Over 800,000 bushels were estimated lost in that state. The corrected losses for all states will be found in the Plant Disease Bulletin Supplement 18.

Relation of Weather in 1920 to Curl.

The widespread epiphytotic of leaf curl in 1920 was no doubt due to the very wet and generally cold April. The winter of 1919-20 was generally mild and the abnormally heavy precipitation and long continued rains during April favored infection and prevented early spraying in many cases. Fortunately, in many sections defoliation resulted so early that the trees were able, in part, to outgrow the effects of the fungus due to continued favorable weather.

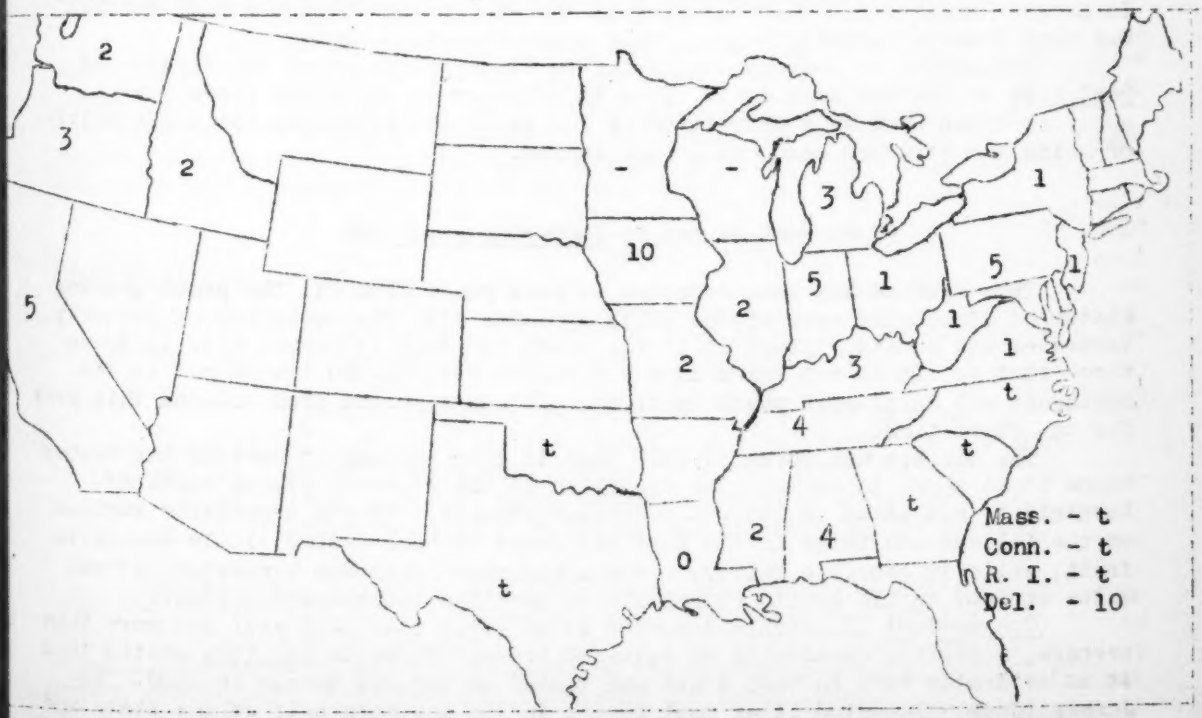

Fig. 14. Estimated percentage loss from peach leaf curl in the United States, 1920.

Varietal susceptibility.

Georgia (McClintock)- All varieties of peach are attacked.

Indiana (C. L. Burkholder)- Crawford most susceptible, complete loss of crop in two counties. Elberta next in susceptibility. In the same two counties the yield was reduced from three bushels to one peck. Belle of Georgia showed about the same susceptibility as Elberta. About 2% of the crop of Champion was lost. Carman, Admiral Dewey, Smock and Salway are resistant.

Illinois (Anderson)- In an orchard where Champion and Elberta were grown side by side, Champion was suffering severely from leaf curl while Elberta showed very little. This observation was made when the disease first appeared in the spring. The orchard was not visited later.

Control of Leaf Curl.

It is the general opinion of the collaborators that the dormant spray of lime sulfur applied either in the fall or early in the spring will control leaf curl. However, there were several reports, especially from Maryland, Kentucky and Illinois, that indicated some failures to control it even with the usual lime sulfur applications. The failure to control in several states is stated to be due to the fact that the spring application was made too late. In California, E. H. Smith stated that the spring application did not control the disease satisfactorily while the fall application was successful. In Oregon Barss stated that spraying in the winter with Bordeaux will control but many growers neglect to spray with large resulting losses.

Burkholder in Indiana and Hesler in Tennessee reported the failure of Scalecide to control leaf curl. This information is important since this spray is often used as a dormant spray for scale and indicates the desirability of using the standard commercial lime sulfur.

Black spot caused by Bacterium pruni EFS

This disease has been reported in past years from all the peach-growing states of importance east of the 100th Meridian with the exception of Kentucky, Tennessee and Kansas. There is little doubt but that it occurs also in these three states. It is not found in the northern New England States nor in the Northwest and California peach sections. It was reported from Arizona this year for the first time.

The disease was worse in 1920 than in 1919 throughout most of the states where it is known to occur. The condition in the Atlantic States south of Virginia is not known on account of meager reports. It was especially serious on the foliage and twigs in the East but seems to have caused little damage to fruit, while in the Ohio Valley, where a big peach crop was harvested, it was quite serious on the fruit, especially in northern Indiana and Illinois.

Connecticut (Clinton)- Reported it as worse than last year and more than average, appearing especially on weakened trees. Chupp in New York stated that it is evidently rare in that state and caused no serious damage in 1920. New Jersey (Cook)- Reported it as most severe in the southern half of the state and

about the same as in 1919. In Delaware Manns stated that the "disease is becoming more severe each year. Many trees are defoliated and cambium severely injured by infection; many trees are killed outright". Maryland reported the usual amount of damage. Virginia (Fromme)- Reported severe defoliation in some orchards but no fruit spots seen. The disease was worse than average and worse than last year. "The injury was intensified and also confused by injury from late frosts." The earliest reported appearance was on June 17 at South Richmond. No reports of the disease were received from the important peach region of Georgia, North Carolina and South Carolina. Mississipoi (Neal)- Reported more damage than usual caused by severe spotting and premature defoliation. The first report of the disease was June 1 at Meridian. Texas reported the disease as important, causing shot hole of leaves and stem cankers. Arkansas (Rosen)- Reported "infections numerous and common in southwestern part of state where the frost of April 5 defoliated and otherwise weakened the trees". Ohio (Selby)- Reported the leaf spot as more prevalent than last year. R. C. Thomas stated "quite serious losses through defoliation have come to our attention". In Indiana, according to Gardner, the 1920 infection was the worst ever known, especially in the southwest corner of the state, where most of the commercial peaches are grown. It caused a severe spotting of the green fruit early in the season and serious defoliation. It was especially injurious where hail had bruised the fruit. Illinois (Anderson)- Reported most serious damage to fruit through spotting and cracking. There was only slight defoliation. The disease was worse than it has ever been since its appearance in the state in 1915. It was common in Missouri. The first report of the disease from Arizona was made by J. G. Brown, who states that a few trees in a garden at Tucson were found infected and a loss of 10% for that state is reported.

Susceptibility of Varieties.

R. C. Thomas in Ohio states that the lemon-free varieties are especially susceptible. C. L. Burkholder in Indiana states that J. H. Hale is the most susceptible variety. Elberta is not so susceptible. In Illinois J. H. Hale was found more susceptible than Elberta, although the latter variety was quite generally affected. The white-meat varieties were not found diseased but no extensive observations in badly diseased orchards were made.

Control of Black Spot.

The following interesting report was made by C. L. Burkholder, Department of Horticulture, Purdue Experiment Station, Indiana:

> "Summer sprays of self-boiled lime sulfur gave no control. Orchards having received several heavy applications of barnyard manure during their history showed remarkable resistance. Two or three applications of nitrate during the current season had no effect on the severity of the disease."

In Illinois, Anderson observed that in those orchards where nitrate of soda was applied and cultivation given, the disease was not checked. W. S. Brock, Department of Horticulture, Illinois Experiment Station, made extra heavy applications of nitrate of soda and cultivated thoroughly without any marked improvement over trees not receiving the fertilizer.

Black mold rot caused by Rhizopus spp.

This rot seems to be more prevalent in western than in eastern fruit but the reports of the inspectors of the Bureau of Markets indicate that it is of great importance in all sections of the country. It is primarily a rot which develops in transit and on the fruit in the market. Only one report of this important disease was received from the state collaborators in 1920. Fruit from Illinois orchards was watched in the market and it was observed that Rhizopus rot developed to a greater extent than did brown rot. This disease should receive more attention from the pathologists. The fact that it is so often associated with brown rot makes the reports of the inspectors rather confusing as to the relative importance of the individual rots.

Table 27. Losses from black mold caused by Rhizopus spp., as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Alabama	3	35-42	Associated with brown rot.
	4	3-13	" " " "
California	5	30-63	
	43	1-27	
Colorado	6	2-8	Some complete decay.
Georgia	3	50-60	Associated with brown rot.
	22	25-49	Associated with brown rot in most cases.
	73	1-23	Brown rot in many cars.
Idaho	1	2	
Illinois	4	2-27	
Indiana	2	2-50	
Maryland	3	2	
Michigan	2	45-47	With brown rot.
	5	2-13	
New York	17	55-98	Much brown rot.
	18	25-45	Associated with brown rot.
	54	2-22	" " " "
North Carolina	8	1-11	
Ohio	3	4-15	Associated with brown rot.
Pennsylvania	1	9	" " " "
Unknown origin	2	3-12	Brown rot in one car.
Utah	1	8	
Virginia	1	17	
West Virginia	1	30	Associated with brown rot.
	Total		282
	Total number of cars inspected		1298

Yellows, rosette and little peach (cause unknown)

Yellows was reported in 1920 from Connecticut, New York, New Jersey, Pennsylvania, West Virginia, Tennessee, Maryland and Ohio. It probably occurs

in other states in the eastern part of the country. A special survey was made by the Pennsylvania Department of Agriculture in nine eastern counties to determine the extent and importance of yellows in that state. Below are given extracts from a report of this survey, together with the results of a questionnaire sent out to other states by the Pennsylvania Department of Agriculture. We are indebted to J. G. Sanders and W. A. McCubbin for this very excellent report.

> "During the recent summer this Bureau has made a hurried and limited survey of the Yellows situation in nine eastern counties, but particularly in Cumberland, Lancaster and Lebanon. In this survey 104 orchards were covered in nine counties, involving 111,437 peach trees. Of these 8,710 were definitely affected by Yellows (about 8%), and 5,277 were suspicious, a total of 13,987 or 12.5%. In other words, one tree in eight in these orchards was either diseased or suspected of the disease. The "Yellows" disease was found in plums in 179 trees. No percentage record of the disease in plums can be given.
>
> "Only 18 peach orchards were found in which yellows was not present to a greater or less extent. The amount of disease in one orchard ran as high as 95%, and 6 of the orchards had above 75% of yellows.
>
> "The loss to the peach growers at the low valuation of $5.00 per tree would thus amount to $69,935.00 to say nothing of the danger of spread, and the loss from the orchard due to increase in blank spaces beyond the profitable limit."

Table 28. Peach yellows survey in Pennsylvania, 1920.

County	Orchards covered	No. of trees in these orchards	Yellows: trees found	Suspicious	Have any trees been removed for Yellows recently? Yes	No
1. Bucks	3	5650	486	2400	0	3
2. Chester	6	10546	256	72	4	2
3. Cumberland	25	30065	2133	698	8	17
4. Dauphin	2	2800	249	87	1	1
5. Lancaster	14	12746	742	237	10	4
6. Lackawanna	1	200			0	1
7. Luzerne	4	1800	6	4	0	4
8. Montgomery	8	17900	609	244	4	4
9. Lebanon	41	29730	4229	1535	32	9
	104	111437	8710	5277	59	45

Table 29. Summary of information obtained from various state officials on peach yellows by the Bureau of Plant Industry of the Pennsylvania Department of Agriculture, December 1919.

	1	2	3	4	5	6
STATE	HAVE YOU SECURED COMMERCIAL CONTROL BY REMOVAL?	SPECIAL INSPECTION SERVICE, OR DEPENDENCE ON GROWERS RECOMMENDED	STATE OR COUNTY CONTROL ADVISABLE?	HOW MANY INSPECTIONS PER YEAR?	WHAT PRECAUTIONS AGAINST NURSERY INFECTION?	IS IMMEDIATE REPLANTING SAFE?
Mich.	Yes	Special twp. insp. under State supervision. Growers useless	State control in each twp. or Co.	One week before ripening	Care in budding	Replant after
N. Y.	Yes	Special, not growers	State better than County	Two	Removal of diseased trees nearby	After winter
N. J.	Checked, not eradicated	State, not growers		August	Precaution in securing bud wood	Perfectly safe
Del.	Some results not thoroughly tried	State, not growers	State control with the assistance of Counties	Two, at least first year	Care in budding	Entirely safe
Md.	Yes	Special with owners cooperation	State	No set number	Nursery insp. of vicinity	After winter
Va.	No disease or little recently				Care in budding	
W. Va.	Yes	Special, at least at first	State in Counties	Begin in July and continue through out the summer	Removal of neighboring orchard trees	Probably yes

Little peach was reported as more serious in New Jersey than last year and the cause of heavy loss. This is the only report of the disease in 1920.

Peach rosette was reported in 1920 from West Virginia, Georgia and Tennessee. In West Virginia it was observed by Prof. J. L. Sheldon on two trees in Morgantown. Hesler observed it in one orchard in middle Tennessee. It is regarded as serious in Georgia and slightly more prevalent than last year. McClintock states that it results in the death of the tree in one or two years.

Other diseases.

Rust caused by Puccinia pruni-spinosae Pers. was reported from Georgia, little importance; general; late in season. Texas, unimportant; late in season; and Maryland, leaf injury on nursery stock.

Powdery mildew caused by Sphaerotheca pannosa (Fr.) Lev. was reported from Texas and Washington as not important this year.

Die back associated with Valsa leucostoma Fr. was reported as widely distributed in western New York on peach twigs, apparently following winter injury. It was also reported from Ohio and Indiana. In the latter state Burkholder states that the disease is severe in sod or neglected orchards and can be prevented by fertilizing and cultivating.

Coryneum blight caused by Coryneum beijerinckii Oudem. was reported as less severe than in former years but of importance in some sections of Idaho and Washington. Also reported from Oregon and Fresno County, California as causing slight damage.

Crown gall caused by Bacterium tumefaciens Sm. & Towns., while no doubt generally distributed, was reported in 1920 from only three states, New Jersey, Texas (very important; 2% loss) and Ohio. In Ohio, R. C. Thomas reports that in one orchard nearly all trees of Early Crawford and Trumbull were infected while no Elbertas were diseased.

Chlorosis is reported as a very important disease in Texas by Taubenhaus, who states that it is caused by excess of lime in the soil and occurs in all soils showing such excess.

Leaf spot caused by Cercospora circumscissa Sacc. (?) reported from Michigan.

Blue mold caused by Penicillium sp. was reported by the inspectors of the Bureau of Markets as present on peaches from California, New York and North Carolina. Five cars were inspected and decay arranged from 8-57% with an average of 18%. Brown rot or Rhizopus rot was present in each case.

Winter and Frost Injury.

In Connecticut, Rhode Island, Massachusetts and the states north, practically the entire peach crop was killed in the bud by low winter temperatures. The low temperatures of December, 1919, killed many peach trees in the Pacific Northwest. Hungerford reported "total loss of crop in Lewiston section; much loss in south Idaho". Heald and Dana stated for Washington: "Benton County reported 50% loss of wood; Yakima district nearly as bad". See especially the report of D. F. Fisher, under winter injury to apples.

The freeze of April 5 hit the Arkansas peach section when the trees were in bloom and almost completely wiped out the crop in that and neighboring states. Elliott in Arkansas stated that 99% of the peaches were destroyed by this frost. The Bureau of Crop Estimates gives Arkansas an estimated yield of 117,000 bushels in 1920 as compared with 1,280,000 bushels in 1919. The estimate for 1920 is probably much too high. Frost also destroyed the New Mexico crop.

Freezing of the buds was also reported as serious in all parts of New York with an estimated loss of 20-30%. West Virginia also reported serious frost injury.

The after effects of the severe winter of 1917-18 are still evident in many sections. Trees were so weakened at that time that, while living, they are in a devitalized condition. A few of these trees die each season and many are attacked by wood rotting fungi such as Polystictus versicolor and Schizophyllum commune.

PLUM and PRUNE

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

The range of this disease corresponds to the range of its hosts. All the states reporting on the malady state that it is very important and is usually the limiting factor in plum growing. In some states, for example Indiana and Illinois, commercial plum growing has been abandoned by most fruit growers on account of the severity of this disease and the difficulty of its control.

In most states the fruit rot was the most serious form of the disease in 1920 but Massachusetts, Kentucky, Illinois, Michigan, Wisconsin and Minnesota reported blossom and twig blight common. This seems to have been the most serious form of the disease in Wisconsin and Minnesota this season.

Vermont (Lutman) reported more than average amount of brown rot, causing 10% loss over the state. Massachusetts (Krout) reported the disease as prevalent throughout the state. Osmun reported it on twigs and fruit and stated that it is very important as a plum disease. New York (Chupp) reported the disease as about the same as last year but very important wherever plums are grown and causing a loss of 8-10% in the state. New Jersey has a few plum trees but the disease was very destructive in 1920 as well as in 1919. Pennsylvania reported a 25-30% loss to plums from brown rot. Kentucky reported blossom blight and some rotting of fruit. Not many plums are grown in Tennessee but the disease was common wherever plums were found. Georgia had a wet season and more brown rot than usual. A 75% loss was reported. Texas reported a 10% loss. Arkansas (Elliott) reported a 10% loss and a general prevalence of the disease. A very serious loss was experienced in Ohio where the weather was favorable for the disease. Indiana reported more than last year and more than usual, especially on door-yard trees. In Illinois few trees were seen where brown rot had not taken most of the crop. There was also considerable twig blight in some orchards. A 20% loss is estimated. Michigan reported cankers and twig blight due to the brown rot organism. Dry weather held the rot in check in Wisconsin so that there was not as much as usual. However, there was serious twig and blossom blight. The disease is especially important on European plums. Most serious in Polk, Pierce and Door Counties. Minnesota reported more than usual. Very important especially as blossom, leaf and twig blight. Not so much disease appeared on the fruit, owing to dry weather in July. It was very abundant, however, in Morrison County. Iowa reported brown rot as less severe in 1920 than in 1919. It is reported as serious in the Northwest on plums and prunes west of the Cascades. In Washington it was reported as one of the serious troubles of prunes in Clark County. Barss in Oregon reported more than 1919 but not unusually troublesome. Early rains cracked the ripe prunes and brown rot readily attacked many orchards. No reports were received from California, the big prune state.

Control measures for brown rot were not specifically mentioned by many of the collaborators. Selby in Ohio stated that July sprays of Bordeaux and lime sulfur glue were used with good results.

Dates of first observation of brown rot:

New York, June 21, Ontario County
Pennsylvania, August 14, State College
Arkansas, June
Ohio, June 15
Illinois, June 9, Rockford
Wisconsin, May 25, Sturgeon Bay
Minnesota, May 27 (Blossom)
June 10 (Fruit), Vergas

Table 30. Losses from brown rot of plum and prune caused by Sclerotinia cinerea, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: Plum: No. cars	Plum: Percent	Prune: No. cars	Prune: Percent	Remarks as to seriousness of decay
California	2	3-5			
Michigan	6	25-45			
	13	2-18			
New York	2	50-77	5	4-25	Associated with other decays.
	7	25-45			
	47	1-23			
Ohio	1	47			Associated with Rhizopus rot.
Virginia	1	80			Very severe decay.
Idaho			4	2-10	Associated with Rhizopus rot and blue mold rots.
	Total				88
	Total number of cars inspected				182

Pockets caused by Exoascus pruni (Berk.) Fckl. and E. communis Sad.

This disease seems to be on the increase, especially east of the Mississippi River. New York (Chupp) reported it more abundant than usual but not important. It was first observed in Jefferson County on June 2 and was reported from four other counties widely separated. Fromme reports it from two localities in Virginia. The first report was from Sealston where, on a large cultivated tree, the crop has been ruined each year for the past four years. In Tennessee Hesler stated that the disease was general, having been especially bad in higher altitudes. It was regarded as more prevalent in Ohio and was first reported June 6. Indiana had one report of pockets. It was reported by Anderson in Illinois for the first time. Every plum on four large trees near Urbana was diseased. They were first observed on June 1. Coons reported the disease as severe in Michigan this season. In Wisconsin, more than the average loss occurred, according to Vaughan. Minnesota stated that "plum pocket was fairly abundant and did considerable damage. Very important in some localities. The first report was on June 14 at Detroit". Iowa also reported more than the usual damage. This disease was not reported from the western states.

It is interesting to note that both peach leaf curl and plum pockets were worse this year than usual. It is probable that the very wet April weather which prevailed over most of the region where these diseases were prevalent was responsible for the epiphytotics. It may also be noted that all the reports as to the date of appearance were between June 1 and June 14.

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

This disease probably occurs in all the states where plums are grown but it has not been reported from Georgia and Florida in the East, nor from the Pacific Coast States in the West, although it is found on cherry in the

Northwest. It seems to be of minor importance in the South and Southwest sections of the country. In 1920 it was reported from Connecticut, New York, New Jersey, Pennsylvania, West Virginia, Ohio, Illinois, Missouri and Minnesota. It was not regarded as especially severe in any of these states but in Pennsylvania Thurston and Orton stated that in one orchard in Carbon County 150 trees out of 350 were removed. All varieties were attacked. In Illinois it is especially prevalent in Vermilion County. In Minnesota it was very common on wild species of plums but rarely found in cultivated.

Black spot caused by Bacterium pruni EFS

Reports on this disease were received from only four states, New Jersey (one report), Pennsylvania (on fruit), Texas (important; causing shot hole and stem cankers; generally distributed), and Ohio (normal prevalence).

Leaf spot caused by Coccomyces prunophorae Higgins

This disease was reported from New York (not important), Pennsylvania, Ohio (more than usual), Wisconsin (general but unimportant), and Minnesota (general but of little importance).

Other diseases.

Scab caused by Cladosporium carpophilum Thüm. was reported from Wisconsin as more prevalent than usual but of minor importance, from Missouri where one report was received, Minnesota where it was more abundant than usual, slight losses resulting, and from Oregon.

Powdery mildew caused by Podosphaera oxycanthae (Fries.) De Bary was reported from Minnesota.

Blight caused by Coryneum beijerinckii Oudem. was reported from Washington.

Rust caused by Puccinia pruni-spinosae Pers. was reported as widely distributed but of little importance in Texas. It was also observed in Northampton County, Pennsylvania.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Oregon where it was general.

Bark disease caused by Valsa leucostoma (Pers.) Fr. was reported from Ohio.

Wood rot caused by Fomes pomaceus Pers. was reported from Minnesota. Another wood rot due to Polyporus chioneus was reported by Sheldon from West Virginia.

Leaf spot caused by Coccomyces sp. was reported from Oregon.

Shot hole was reported from Minnesota as fairly abundant and causing considerable injury. It is thought that the disease in most cases is due to a Phyllosticta.

Blossom blight caused by Monilia sp. (not Sclerotinia cinerea) caused some large losses in Oregon but on the whole the damage was not great.

Rosette, cause unknown, was reported from Georgia.

Silver leaf, cause unknown, was reported from Oregon. First report June 8 at Newberg where a number of three-year old trees with typical symptoms of silver leaf were observed.

Drought spots were reported as general on plums and prunes throughout Washington and Oregon. Appeared the last of July and early August. Much of

the affected fruit matured well, showing little damage, according to Barss. A similar, if not identical, trouble was reported from Michigan by Coons as common on plums and cherries. "Caused a skin blackening with slight flesh involvment."

Armillaria root rot caused by Armillaria mellea Vahl. was reported from Oregon causing the usual scattered losses.

Heart rot caused chiefly by Trametes cornea was reported from Oregon where it is increasing on winter injured trees. As high as 93% affected trees have been found in an orchard but the injury on the whole is slight.

Leaf curl and fruit drop of prune was reported as serious in southern Idaho and attributed by Hungerford to lack of available moisture.

Winter injury and frost injury. Winter injury was reported from Oregon, Washington and New York, while frost injury to blossoms was reported from West Virginia and Washington. In general, some frost injury resulted in the same localities where peaches were injured by late frosts. (See under peaches.) For winter injury to prunes in the Northwest see the special report of D. F. Fisher under winter injury to apples, pages 54-56.

Table 31. Losses to plums and prunes from Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay			
	Plum		Prune	
	No. cars	Percent	No. cars	Percent
California	14	5	3	13
Michigan	1	30		
New York	7	20	2	21
Ohio	1	47		
Oregon			1	3
Washington			4	6
Unknown origin	1	7	1	4
Total				44
Total number of cars inspected				182

Table 32. Losses to plums and prunes from blue mold rot caused by Penicilium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay				Remarks as to seriousness of decay
	Plum		Prune		
	No. cars	Percent	No. cars	Percent	
California	5	5			
Michigan	3	8			
Idaho			22	4	Rhizopus rot in several cars.
New York	6	30	1	17	Mostly brown rot.
Washington			2	3	
Unknown origin	1	7	2	3	Rhizopus rot in one car.
Total					45
Total number of cars inspected					182

CHERRY

Leaf spot caused by Coccomyces hiemalis Higgins

The year 1919 was considered one of the worst for this disease and a marked improvement over that year was noticed in the reports of 1920. The disease was much less serious in most sections of the country but seemed to have caused about the same loss in Michigan, Wisconsin and Minnesota. New York reported less leaf spot than last year but about the same as an average year. In southern New Jersey it was very serious in unsprayed orchards. Haskell reported a 25% defoliation on 150 sour cherry trees at Hammonton, New Jersey. Virginia reported less than last year but generally prevalent and often severe. Hesler in Tennessee reported a general distribution, with little crop injury. Gardner reported leaf spot as very destructive in Indiana and about the same as last year. In Illinois the disease was much less severe than in 1919 when a serious epiphytotic occurred. It was generally distributed, however. In Michigan Coons reported it as extremely common, with the loss of a whole crop of Morellos in one county due to slow ripening. Wisconsin reported the disease as about the same as an average year and severe where the trees were not sprayed. Iowa reported a trace of the disease. It is also reported from Washington.

Varietal susceptibility.

Hesler in Tennessee observed an orchard of 3000 trees of mixed varieties in which English Morello was extremely susceptible, Early Richmond moderately so, and Montmorency less than Early Richmond. The English Morello was almost completely defoliated. Coons in Michigan states that Morello was especially affected in 1920.

The following list of varieties, based on their relative susceptibility, was made from notes taken by Anderson in Illinois during 1919 and 1920 on a large variety plantation on the experiment station grounds. In the bad epiphytotic year of 1919 none of the varieties were able to hold their leaves except the Bing which, while the leaves were badly spotted, showed little defoliation. The letters in parentheses following the variety name indicate the species to which the variety belongs, (a) = Prunus avium (c) = P. cerasus and (c x a) = P. cerasus x P. avium.

Resistant

Schmidt Bigarreau (a)
Olivet (c)
Bing (a)
Windsor (a)
Gov. Wood (a)

Moderately Resistant

Yellow Spanish (a)
Napoleon (a)

Susceptible

Montmorency Ordinare (c)
Early Richmond (c)
Dychouse (c)
May Duke (a x c)
Royal Duke (a x c)
Late Duke (a x c)
Burbank (a)
Rockport (a)
Paul (a)
Terry Early (c)
Wragg (c)
Ostheimer (c)
Lambert (a)
Suda Hardy (c)
English Morello (c)
Princess Christine (a)
Reine Hortense (c)
Margarite
Black Tartarian (a)

Nature of injury.

The primary result of infection by Coccomyces hiemalis is defoliation. This usually takes place with unusual promptness, considering the nature of the injury. On the sweet or large leaf species (Prunus avium) the spots are small and very numerous, sometimes covering almost the entire surface. A bronze, rather than a yellow color, is most often noticed as a result of infection, while on the sour cherries (Prunus cerasus), yellowing usually results. The spots are larger and less numerous on the leaves of the latter species. Some varieties retain their leaves much longer than others although they may be as heavily infected. Some varieties, after losing the first or lower leaves on a twig, start a new growth the same season, while others form their winter buds and go into the dormant condition.

The secondary effect is noticed on the fruit which remains quite small and does not ripen properly. Hesler stated that the fruit pedicels were commonly diseased in Tennessee this season. Of course the tree is weakened for the fruit crop of the following year. Serious stunting of cherry trees in the nursery results from this leaf spot.

Control measures.

Vaughan in Wisconsin stated that this leaf spot is effectively controlled with lime sulfur 1-40 and lead arsenate, combined with early spring plowing.

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

Black knot has been reported from most sections of the country as occurring on either cultivated or wild species of cherry. However, no reports have ever been received from California. It has never been observed on cultivated cherries to a damaging extent in the western and mid-western states. In the eastern part of the country, however, it is frequently very destructive. There are reasons to believe that this fungus has several biologic forms. For example, in Pennsylvania and New York it has been reported as very common and destructive to sour cherries, while in Indiana and Illinois the sour cherry, growing alongside of badly diseased plum orchards and exposed to infection from all quarters, rarely shows the disease. In Idaho, where Prunus virginiana is badly infested, the cultivated cherries remain free from this disease. The same is true in some sections of Minnesota where black knot is found on at least three species of wild Prunus but rarely found on cultivated cherries. Attention has been called by Gilbert (Phytopath. 3: 246-247. 1913) and Stewart (Am. Journ. Bot. 1: 113-114. 1914) to the possibility of biologic strains, especially among wild hosts.

Reports of black knot on cherry in 1920 were received from Connecticut, New York (general; sour cherries more susceptible than sweet), Tennessee (general; slight importance), Arkansas (on wild cherry), Ohio, Minnesota (Prunus virginiana and P. serotina), Washington (choke cherry, P. virginiana).

It is advisable when reporting on this, as well as other diseases, for the collaborators to indicate whether the report applies to sour or sweet cherries, or to wild or cultivated species, and, when possible, indicate the species. The reports would be especially valuable if the relative prevalence of black knot on the various species in your state could be given.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Rot of cherries was not reported as generally serious in 1920. However, it was reported as especially severe in New Jersey, Ohio and Tennessee. Clinton in Connecticut stated that he received one report of a 50% loss by killing of fruit spurs and small twigs. New York (Chupp) reported less brown rot than last year and slight damage. In Pennsylvania, McCubbin estimated the loss at 15%. Virginia reported the disease as "very severe in occasional home plantings". Hesler in Tennessee stated that there was a severe outbreak in 1920 with twig infection common and fruit rotting badly. Elliott estimated a 5% loss in Arkansas. It was more prevalent than usual in Ohio on account of abundant rainfall in April and May. Melhus stated that it was less prevalent in Iowa, with an estimated loss of 1%. The disease was also less severe in Illinois on account of a dry May. Michigan reported the disease. Minnesota reported it as more prevalent than usual, but unimportant. In Washington, Heald and Dana stated the horticultural inspector reported a 50% loss in Lewis County.

Dates of first observation of brown rot:

Connecticut	- August 2	Virginia	- June 17 (Danville)
New York	- June 14 (Columbia County)	Ohio	- May 27
Pennsylvania	- July 25 (Kittanning)	Minnesota	- June 11 (Excelsior)

Table 33. Losses from brown rot caused by Sclerotinia cinerea, as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
California	24	2-25	Associated with other decays.
Idaho	2	2-4	Associated with Rhizopus rot.
Michigan	3	50-70	Associated with other decays.
	5	25-50	" " " "
	4	10-25	" " " "
New York	7	2-25	" " " "
Washington	1	3-5	Associated with Rhizopus rot.
Unknown	2	5-9	Associated with other decays.
	Total		48
	Total number of cars inspected		135

Powdery mildew caused by Podosphaera oxyacanthae (Fries.) De Bary

This disease has been reported in the past from most of the states where cherries are grown. The reports for 1920 indicate that it is not serious in any of the states. In some states this is a rather important nursery disease since it occurs on the terminal leaves of rapidly growing shoots, the condition which exists in the scions in the nursery rows. Reports were received from New

York, Pennsylvania, West Virginia, Tennessee, Ohio, Indiana, Illinois, Michigan, Minnesota, Iowa and Washington.

Other diseases.

Blossom blight caused by Monilia sp. (not Sclerotinia cinerea) was severe in certain localities in Oregon. It probably occurred throughout western Oregon, causing blighting of blossom and spurs..

Fire blight caused by Bacillus amylovorus (Burr.) Trevisan. was reported from Ohio. It was found in Seneca County on June 2. It has been previously reported from Ohio (1910, 1911) from New Mexico (1918), and Washington (1915).

Shot hole caused by Cercospora circumscissa Sacc. was reported from Ohio; caused by Phyllosticta prunicola Sacc. was reported from Minnesota.

Blight caused by Coryneum beijerinckii Oudem. was reported from Washington as causing more injury than last year.

Coniothyrium blight caused by Coniothyrium sp., a new disease of the cherry, was reported by Coons from Michigan (Van Buren County).

Scab caused by Cladosporium carpophilum Thüm. was reported from Iowa.

Mushroom root rot caused by Armillaria mellea Vahl. was reported from Washington west of the Cascades.

Witches broom caused by Exoascus cerasus (Fckl.) Sadeb. was reported as being very common in western Washington.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Ohio, New York and Washington.

Gummosis, cause unknown, was reported as serious in Indiana. It was also reported from Washington.

Bacterial gummosis caused by Pseudomonas cerasus Griffin was reported from Oregon causing cankers and blossom blight and from Washington west of the Cascades on sweet cherries.

Winter injury was reported from Washington, Ohio, New York and Michigan. In Michigan it dates back to the bad winter of 1917-18. For injury in the Northwest see under winter injury to apples, Hungerford and Fisher reports, pages 54-56.

Frost injury to cherries occurred in much the same area as was subject to loss in the case of peaches and plums. (See pages 81 and 85.)

Table 34. Losses from blue mold rot caused by Penicillium sp., gray mold rot caused by Botrytis sp., and Rhizopus rot caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of Shipment	Blue mold rot		Gray mold rot		Rhizopus rot	
	No. cars with decay	Average percentage of decay	No. cars with decay	Average percentage of decay	No. cars with decay	Average percentage of decay
California	5	5	18	8	41	8
Idaho	3	3	2	17	10	8
Michigan	11	43	2	31	5	49
New York	4	8			2	9
Oregon	1	1			4	6

Origin of shipment	Blue mold rot: No. cars with decay	Blue mold rot: Average percentage of decay	Gray mold rot: No. cars with decay	Gray mold rot: Average percentage of decay	Rhizopus rot: No. cars with decay	Rhizopus rot: Average percentage of decay
Washington	6	17	3	23	6	18
Unknown	1	2			2	8
Totals	31		25		70	
Total number of cars inspected.....			135			

APRICOT

Scab caused by Cladosporium carpophilum Thüm. was reported from Texas as generally distributed and fairly important. It was about the same as last year, causing a 1% loss.

Blight caused by Coryneum beijerinckii Oudem. was reported as occurring in Washington and serious in some sections of Idaho. It was also reported from Fresno County, California by J. P. Benson.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt. was reported from California only, although it probably occurred to some extent in other states where this fruit is grown.

Shot hole caused by Cylindrosporium padi Karst. was reported from Texas as relatively important.

Winter injury. "Fifty percent reported killed in Benton County," (Washington). For injury in Idaho and the Northwest see winter injury to apple, pages 54-56.

Frost injury. "Frost has killed the apricot blossoms as well as some of the late peaches" (Weekly crop notes for New Mexico, March 28 to April 3, 1920). A peculiar effect of frost injury was observed in southern California by Arthur I. Rittue.

> "In January 1920 warm weather caused the trees to bloom; then a cold wave killed the blossoms, causing a condition of near 'sour sap'. The trees bloomed from three to four times before setting fruit. One rancher, when he saw the trees begin to bloom, stopped the flow of sap by chilling the roots through irrigation. He had practically no disease in his orchard. The disease shows as an excessive bleeding of the entire tree, a gummy substance coming through the pores and hardening on the branches and twigs."

Gummosis was reported by John P. Benson, county agent, Fresno County, California, as causing a medium amount of damage in that county. It was thought to be of bacterial origin.

Crown gall caused by Bacterium tumefaciens Sm. & Towns., was reported as very serious in California.

Arthur I. Rittue gives the following report:

> "Although found in many of the very old orchards on bearing trees, this disease is practically confined to nursery stock, due to the fact that infested trees are thrown out on arrival from the nurseryman, and before the stock is delivered to the rancher. The number of young trees thrown out of shipment from nurseries will vary from 5% to none. In some cases the disease has been so prevalent that entire beds of seedlings grown for root stock have been destroyed, the nurserymen finding crown gall on as high as 90% of the trees."

DISEASES OF SMALL FRUITS

GRAPE

Black rot caused by Guignardia bidwellii (Ellis) V. & R.

This disease was most destructive in 1920 along the Atlantic Coast and in the southwestern states. It is evident from the reports that it is not a serious trouble in the large commercial regions where spraying is generally practiced. Where serious damage occurs it is usually in unsprayed or home vineyards.

Lutman in Vermont stated that there were bad local cases. "A rare disease with us." In Massachusetts black rot was worse than last year and more prevalent than during the average year. It is regarded as important and a 5% loss is estimated. New York (Chupp) reported the disease as "not important". The injury is recorded as a "trace". "Eight or ten years ago there was much black rot but it seems to have disappeared almost entirely." New Jersey (Cook) stated that the disease was important and abundant, but not more so than usual. Pennsylvania reported it as quite prevalent with the largest amount of damage to home grapes; of less importance in the sprayed commercial vineyards of Erie County. Huntingdon County had 60% damage while several other counties reported from 10-20% damage. As high as 50% damage resulted in some vineyards in Virginia where, according to Fromme, the disease was worse than usual. It is regarded as the most destructive disease in this state. West Virginia (Sheldon) stated that from one-third to one-half of the grapes in the gardens about Morgantown were destroyed by black rot. Tennessee reported the disease as being of little importance, but generally distributed. In Texas Taubenhaus stated that it was very important, causing a loss of 4% of the crop. It was about as prevalent as the year previous. In Arkansas it was also common and very important. There was a 5% loss. On account of the wet season in Ohio, black rot was the most serious disease. It was worse than in 1919. Indiana reported only local outbreaks with the leaf spot, the only serious form of the disease. Illinois recorded less than the usual amount of black rot which was largely confined to home gardens. There was some injury to certain varieties in a large vineyard in Union County. Minnesota reported the disease in the southern end of the state mostly on wild grapes. Iowa

(Melhus) reported 15% loss locally, with a state reduction of 2% from black rot. Missouri reported the disease as present. There were no reports from the western grape-growing regions. The disease evidently does not occur in this region. It would be interesting to know the western limit of black rot and it is suggested that the collaborators in the West make a statement as to the conditions in their respective states.

Dates of the first appearance of black rot:

New York	- August 24	Arkansas	- June
Pennsylvania	- July 26	Ohio	- June 25
Virginia	- July 12	Minnesota	- June 10
West Virginia	- June 25		

The collaborators are requested to state on their reports whether the observations were made on the fruit or on the leaves.

It is significant to note that where spraying has been consistently practiced in past years, black rot is not a serious factor. Shear reports that "what little information we have direct is mostly from Virginia, where the rot in the latter part of the season was quite severe even in vineyards that were fairly well sprayed". The generally used spray for black rot is Bordeaux and in most cases this has been reported as successful in controlling the disease.

Downy mildew caused by Plasmopara viticola (B. & C.) Berl. & de Toni.

The season of 1920 was remarkable for the small amount of damage done by downy mildew. Only one state, Ohio, reported the disease of importance although Pennsylvania reported it locally severe. It was not reported from any of the western states. In the East it was reported from Vermont (below average), Massachusetts, Connecticut, New York, New Jersey, Pennsylvania (severe locally in widely separated districts, 3% loss), Tennessee, Texas, Ohio, Indiana, Illinois, Michigan, Wisconsin (mostly on wild grapes), Minnesota (more than usual but unimportant), and Missouri.

Dates of first observation:

Connecticut	- August 24	Ohio	- July 6
New York	- June 21	Illinois	- July 7
Pennsylvania	- July 27	Wisconsin	- July 15
Tennessee	- July 11	Minnesota	- July 2
(at an elevation of 1800 ft.)			

Powdery mildew caused by Uncinula necator (Schw.) Burr.

Reported from Pennsylvania (unimportant), Arkansas, Ohio, Illinois (more than usual, especially late in the season, causing early defoliation (?)), Iowa, Minnesota and Missouri. In California, John R. Benson, county agent of Fresno County, states that this disease caused the usual amount of damage. In Oregon it was about as usual and of considerable importance. It seems to have been of very little importance in the East.

Anthracnose caused by Gloeosporium ampelophagum Sacc.

Reported from New York (not important, rather common in Rennselaer County), Georgia (general, causing leaf spot), Arkansas (common, 1% loss), and Ohio (more prevalent than usual).

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Ohio and Washington.

Root rot caused by Ozonium omnivorum Shear was regarded as very important in Texas where Taubenhaus stated that it occurs in soils where cotton has died. He estimates a 5% loss.

Dead arm caused by Cryptosporella viticola (Reddick) Shear reported as quite serious this year in Erie County, Pennsylvania, causing a 2-5% loss. "Probably more important than before realized" (Thurston and Orton). It was also reported from Ohio, New Jersey (rare), and Illinois (Crawford County, where growers said it was causing considerable damage).

Leaf spot caused by Cercospora viticola (Ces.) Sacc. was reported from Ohio.

"Hard berry", cause unknown, was reported as causing a fifty percent loss in one vineyard in Washington. It was characterized by a hard mass in pulp about the seeds. (Frank)

Winter injury. In Washington the severe cold weather of December 1919 caused a loss of 100% of the European varieties and 10% of the American varieties in Benton County.

Table 35. Losses of grapes from gray mold rot caused by Botrytis sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
California	57	50-100	Associated with other rots in the
	80	25-50	majority of cars, in most instances
	208	1-23	blue mold rot.
Michigan	14	2-47	Blue mold rot in some cars.
New York	1	87	
	34	2-40	Considerable blue mold present.
Ohio	1	4	Blue and gray mold rots.
Spain	1	7	
Unknown	2	75-87	Associated with blue mold rot.
	15	2-35	Blue mold rot in all cars.

Total number of cars with gray mold rot..... 413
Total number of cars inspected..... 1573

Table 36. Losses of grapes from Rhizopus rot caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
California	9	55-87	Associated with other decays in
	30	25-47	nearly every car, mostly blue
	213	1-23	mold and gray mold rots.
Michigan	6	3-13	Associated with blue mold and brown rots.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
New York	3	4-13	Associated with blue and gray mold rots.
Canada	3	10-20	Associated with blue mold rot.
	Total number of cars with Rhizopus rot	264	
	Total number of cars inspected.....	1573	

Table 37. Losses from blue mold rot of grapes caused by Penicillium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
California	62	50-100	Other decays also present, principally
	113	25-48	gray mold rot and Rhizopus rot.
	628	1-23	
Michigan	3	25-45	Some gray mold rot and Rhizopus rot
	58	2-20	present.
New York	3	50-65	Considerable gray mold rot and some
	9	25-45	Rhizopus rot present.
	100	2-23	
Ohio	3	4-7	
Pennsylvania	8	2-17	
Canada	9	3-22	Other decays also present.
Spain	13	2-9	
Unknown origin	5	5-15	
	Total number of cars with blue mold.....	1014	
	Total number of cars inspected.....	1573	

STRAWBERRY

Leaf spot due to Mycosphaerella fragariae (Schw.) Lindau.

As usual, leaf spot was reported from practically all the states where strawberries are grown. This disease is common in every state, according to past reports of the Plant Disease Survey. However, the damage resulting from its presence is usually slight. In the New England States the disease was less prevalent than usual. It caused some damage to the Glen Mary variety in Connecticut by attacking the fruit stems. It is also reported as a serious factor in New York causing a fruit pedicel injury which resulted in a partial loss of the crop in some regions. It was reported as abundant in New Jersey and in at least one

case was destructive. Maryland estimated a 6% injury from leaf spot. In West Virginia leaf spot was reported as less injurious in 1920 than in 1919. The Southern States reported the disease as common but not of any great importance. In Mississippi, however, Neal reports that it was causing serious loss in Neshoba County. Elliott in Arkansas reported a 25% injury for this disease. Ohio reported an unusually severe epiphytotic this season but with slight loss. Warfield is regarded as especially susceptible. In Illinois the disease started very early on the new leaves due to the very wet, cold April but did not cause more than the usual amount of damage. William Belt was especially susceptible. Iowa estimates a 5% loss from leaf spot. It was more abundant than usual in Minnesota.

Judging from the reports of 1920 and former years, it would seem that no effort is made to control this disease in commercial plantings. It is probable that there has been an unconscious selection of those varieties which are least susceptible to this disease and in this manner resistant varieties have become generally planted. It is probable that the damage caused by leaf spot is not sufficient in most cases to justify spraying. Temple in Maryland gives the following varieties as susceptible: Sample, Early Osark, Rewastico; and as resistant: Chesapeake, Ekley, Parsons, Superior, Senator Dunlap, Stevens Tennessee.

Gray mold rot caused by Botrytis sp.

Massachusetts (Osmun) reported "much damage from this rot in the field; unusually wet weather has favored the development of the fungus". Damage to certain varieties, especially Premier, was reported from Connecticut. Reports were also received from New York (one patch complete loss), New Jersey (abundant), Maryland (very serious, 2% loss), West Virginia, Alabama, Louisiana, Ohio, Illinois, Michigan, Wisconsin, Washington and California. In Illinois, Anderson observed the rot very prevalent on fruit in many markets. This fruit had been received from the southern states and the fungus had evidently developed in transit. N. E. Stevens, who has made a special study of this disease in Los Angeles County, California, gives some interesting data on its prevalence. (See Plant Disease Bulletin 4: 22. 1920)

The reports of the inspectors of the Bureau of Markets summarized below indicate the seriousness of this rot. Most of the rot developing in transit and in the markets results from infection in the field.

Table 38. Losses from gray mold rot caused by Botrytis sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars.	Percent.	
Alabama	8	5-23	Rhizopus present in several cars.
Arkansas	6	25-51	" " " " "
	15	2-24	
Delaware	8	1-18	Some Rhizopus present.
Florida	1	95	Complete decay.
	3	28-37	
Iowa	2	4-9	
Kentucky	3	3-30	Some Rhizopus also present.
Louisiana	9	2-28	Rhizopus present in several cars.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Maryland	6	4-23	
Michigan	21	2-32	Considerable Rhizopus present.
Mississippi	1	27	
North Carolina	1	15	Mostly Rhizopus rot.
Tennessee	12	30-56	Considerable Rhizopus present.
	25	2-22	
Total number of cars with gray mold rot ...			121
Total number of cars inspected.....			211

Rhizopus rot caused by Rhizopus nigricans Ehr.

This rot was reported from New Jersey (abundant), Maryland - Temple (caused great loss during the latter half of the ripening season, 3% loss), Delaware, Louisiana, Illinois (not as abundant as during previous seasons. Noticed on Mississippi berries in markets.) In South Dakota it was especially prevalent at Brookings where, according to C. W. Michel, it caused serious rotting in the horticultural plots due to especially favorable weather conditions. The following report on an unusual manifestation of the disease is taken from L. E. Melchers' abstract in Phytopathology, January 1921:

> "In 1919 and 1920, the writer observed that unripe strawberries in the field were being attacked by Rhizopus. The fruit was about three-fourths grown and the berries were in the white stage. Wherever the berries touched the soil, infection occurred. The decayed spots became soft and slightly brown. In some fields from 25-35% of the fruit was unsalable. Seasonal conditions, without doubt, have a great influence on the occurrence of this trouble. A few days to a week of cloudy, wet weather, just before the berries begin to turn pink, is the most favorable time for infection. A few bright days will stop this injury. Prior to 1919, no report seems to have been made which shows that Rhizopus has been found on unripe fruit in the field."

Table 39. Losses from leak caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay	Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Ala.	2	37-63		Ky.	4	3-32	Some gray mold
	13	2-27	Some gray mold	La.	39	1-31	" " "
Ark.	7	31-55	" " "	Md.	7	2-35	
	5	8-29		Mich.	7	8-32	Gray mold pres
Del.	21	2-30	" " "	Mo.	2	2-20	
Fla.	2	75-95	Very bad decay	N. Car.	1	15	Some gray mold
	5	25-45	Some gray mold	Tenn.	9	27-60	Gray mold pres

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
Tennessee	15	2-21	Considerable gray mold rot.
Virginia	1	7	
Unknown origin	2	4-12	
Total number of cars with leak		142	
Total number of cars inspected		211	

Leaf scorch caused by Mollisia earliana (E. & E.) Sacc.

Leaf spots of strawberry have been reported in the past by various collaborators under several scientific names. The names which have been used are: Ascochyta fragariae Sacc., Ascochyta colorata Pk., Marssonia potentillae (Desm.) Fisch., and Marssonia potentillae var. fragariae Sacc.

The spot known as the Marssonia spot or leaf scorch, is usually distinguished from the spot caused by Ascochyta by the fact that the latter has a very definite white center, resembling more nearly the ordinary Mycosphaerella spot. Leaf scorch, on the other hand, shows at first an irregular, rather indefinite purple spot which later becomes cinereous. The recent investigation of Dr. R. E. Stone (Phytopath. Jan. 1921) shows that the perfect stage of Marssonia potentillae is Mollisia earliana. This has been reported in the past from Louisiana (Edgerton 1917), Delaware (Cook, 1907-08), New Jersey (Cook 1915 to 1918), Connecticut (Clinton, 1916), Indiana (Jackson, 1916).

Other diseases.

Leaf blotch caused by Ascochyta fragariae Sacc. was reported in 1920 from New York and West Virginia. It has been reported in the past from Delaware and Connecticut.

Chlorosis, cause unknown, was reported from Minnesota.

Crown rot caused by Corticium vagum var. solani Burt was reported as causing loss in various parts of Washington and Idaho. A crown rot was also observed in Indiana and Illinois by Anderson. While large sclerotia were observed at the crown of the plant, these were not typical of Rhizoctonia but more like Sclerotinia. The fungus was not determined.

Leaf blight due to Dendrophoma obscurans (E. & E.) And. was reported as general in Illinois, but not as serious as last year. It is not regarded as important.

Nematode caused by Tylenchus dipsaci (Kühn) Bastian was reported by Barss in Oregon as serious in the coast section of Lane County (several patches), and present in one planting at Corvallis. Forty percent affected plants in one bed.

Root rot, cause unknown. Many reports were received by Anderson from various sections of Illinois. No fungus could be found constantly associated with the disease although a Fusarium was isolated in some cases. Manns in Delaware stated that the plants collapsed after picking, with evidence of root rot.

Slime mold. Hopkins in Missouri had two reports with specimens of plants overgrown with slime mold (Mucilage spongiosa Leyss as determined by Dr. W. E. Maneval). Slime mold has been reported a number of times in past years on strawberries, especially from Nebraska. The most common species reported is Physarum cinereum (Batsch) Pers. Fuligo varians and Diachea lucopoda have also been reported.

CURRANTS

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. was reported from New York, New Jersey, Ohio, Illinois, Minnesota and Iowa. There seems to be no data as to the amount of injury this fungus causes.

Anthracnose caused by Pseudopeziza ribis Klebahn was reported in 1920 from New York, New Jersey, Ohio and Washington. It was recorded as more common in Ohio and Washington than in 1919.

Blister rust caused by Cronartium ribicola Fisch. von Waldh. was reported from Connecticut (not important as it is confined on cultivated Ribes to black and flowering currant - Clinton), New York, New Jersey and Minnesota (on Ribes cynosbati, R. floridum, R. grossularia, R. nigrum, R. oxycanthoides and R. vulgare). The chief importance of this rust is its relation to the white pine blister rust.

Angular leaf spot caused by Cercospora angulata Wint. was reported as common in Illinois, Minnesota, Missouri and Iowa.

Cane blight caused by Botryosphaeria ribis Gross. & Dug. was reported from New Jersey, Indiana and Illinois.

Winter injury was reported from Washington.

Rust caused by Puccinia pringsheimiana Kleb. was reported from Minnesota as causing local damage (on Ribes cynosbati, R. floridum, R. grossulariae, and R. oxycanthoides).

GOOSEBERRY

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. was reported from New York, New Jersey, Illinois, Minnesota and Ohio. It was not considered serious in any state.

Anthracnose caused by Pseudopeziza ribis Kleb. was reported from New Jersey, Indiana, Illinois, Minnesota, Washington and Oregon. In Illinois the gooseberry bushes are commonly defoliated early in the season due to the combined attack of leaf spot and anthracnose.

Powdery mildew caused by Sphaerotheca mors-uvae (Schw.) B. & C. was reported from Indiana, Michigan, Illinois, Minnesota, Idaho, Washington and Oregon. It was regarded as serious in some sections of Idaho and in some plantations in Oregon.

Rust caused by Puccinia pringsheimiana Kleb. was reported from New Hampshire, New York, Ohio, Michigan, Indiana, Minnesota and Iowa.

Winter injury was reported from Washington.

Dodder (Cuscuta sp.) was reported from Minnesota as causing local injury but generally unimportant.

CRANBERRY

End rot caused by Fusicoccum putrefaciens Shear is regarded as the most serious disease of the cranberry in the western cranberry section. A ten percent loss was reported by Heald and Dana from Washington. It was also serious in some places in Massachusetts, and especially on late varieties and late in the season, according to C. L. Shear.

Bitter rot due to Glomerella cingulata vaccinii Shear was reported from New Jersey.

Early rot (scald) caused by Guignardia vaccinii Shear was reported from a number of localities in New Jersey.

Blotch caused by Acanthorynchus vaccinii Shear was reported from New Jersey.

False blossom, of unknown cause, was reported from Washington.

The following report on other diseases was furnished by Dr. C. L. Shear:

> "Black rot due to Ceuthospora lunata caused considerable rot in late kept fruit in Wisconsin.
>
> "Hard rot and tip blight due to Sclerotinia vaccinii were common in Oregon and Washington.
>
> "Red leaf spot caused by Exobasidium vaccinii (Fckl.) Wor. was prevalent in Washington and Oregon.
>
> "Ripe rot due to Sporonema oxycocci Shear was very prevalent in Cape Cod berries which had been kept in cold storage during the winter."

DISEASES OF CANE FRUITS

The following quotation taken from a report of conditions in Wisconsin (Jones, L. K. A survey of disease and insect injuries of cane fruits in Wisconsin, 1919. Ann. Rept. Hort. Soc. Wis. 50: 143-150. 1919-1920) summarized the situation concerning the cane fruit industry in the western Great Lakes region:

> "The cane fruit industry in the state of Wisconsin has declined to such a large extent (about eighty per cent during the past ten years) that it was deemed advisable to make a survey to ascertain, if possible, the reasons for this decline.
>
> "It was found during the survey that diseases and insect injuries usually played an unimportant part in the decrease of acreage, although crown gall can be classed as the limiting factor in the growing of blackberries throughout the state and is also an important factor in limiting black raspberry plantings. Anthracnose on black raspberries, combined with crown gall, has been the chief factor in the decrease in acreage of this cane fruit. The decline of the red raspberry industry has been due, mainly, to economic factors, such as (1) labor at the time of harvest, and (2) other crops and occupations offering a more congenial as well as more remunerative work."

RASPBERRY

Anthracnose caused by Plectodiscella veneta Burkholder

This disease is generally considered as one of the most serious troubles of the black cap varieties. It is found wherever raspberries are grown in this country but appears to be worse in the Mississippi Valley and Great Lakes Region than elsewhere. It was not reported as more destructive in 1920 than in former years in most of the states but Indiana regarded it as especially serious this season. The following states reported the disease in 1920: New Hampshire, Massachusetts (worse than last year, important this season), New Jersey (sometimes destructive), Virginia, Tennessee, Arkansas (50% of the crop injured), Ohio, Indiana (worse than last year and worse than average, estimated loss of 10%), Illinois (about the same; serious factor in reducing crop, due to dry July weather; 10% loss), Michigan (common), Iowa (10% loss), Missouri, Wisconsin, Minnesota and Washington.

In Illinois, Anderson stated that good results were obtained by one grower who sprayed with lime sulfur, following the Michigan recommendations. No other reports on control were received.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall is undoubtedly more serious on raspberries than any other fruit crop. It is often prevalent to such an extent that the patches have to be frequently renewed and many growers in the middle west have given up this crop on account of crown gall. Few reports of the disease were received, however, from the state collaborators in 1920. Massachusetts reported the disease as rather serious but about as usual. New York stated that crown gall was serious only in isolated cases. It is regarded as destructive in New Jersey and most abundant in the southern end of the state. Ohio estimated a 2-5% loss. Illinois reported a 2% probable loss. In a two-year-old patch examined, 25% of the plants were found with crown gall. It is also one of the most serious nursery problems in the state. Wisconsin reported crown gall as one of the limiting factors in raspberry production. Minnesota and Washington reported the disease.

No reports were made on control measures. It is suggested that collaborators report on what efforts are being made in their respective states to reduce this loss by nursery inspection. It was found in Illinois that the nurseries were very careless about sending out diseased plants.

Yellows (cause unknown)

Wherever this disease occurs it is regarded as very important. It is quite desirable that more information be obtained concerning the geographic distribution of yellows. The accompanying map indicates the distribution of the disease based on information in the files of the Plant Disease Survey office.

Massachusetts reported yellows as "very important". In New York yellows was also regarded as "very important, especially in susceptible plantings". A 5-10% loss was recorded. "The wild raspberries are fast being killed by yellows." Ohio reported the normal amount of yellows and mentioned the Cumberland variety as being especially susceptible. Illinois reported "this disease seems to be increasing in importance and an unusual number of specimens

have been received this year". It has been observed on red raspberry varieties only in this state. Wisconsin reported the disease as "important on red raspberries, scattering on black raspberries". Michigan and Minnesota reported it as common. Oregon (Barss) reported what seems to be yellows for the first time.

Orange rust due to Gymnoconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens (Schw.) Arth.

Orange rusts of raspberry seem to be generally considered of minor importance. It was reported in 1920 from Connecticut, New York (important in some plantings; Monroe County - "on red raspberries near Hilton"; Jefferson County - "black caps damaged severely"; Orange County - "one bad case, whole crop ruined"), Ohio, Illinois, Minnesota and Wisconsin.

Leaf spot caused by Septoria rubi Westd.

Leaf spot was reported from New Jersey, Pennsylvania, Arkansas, Ohio, Illinois, Iowa and Wisconsin. There are no reports of this disease on raspberry from western states in the files of the Plant Disease Survey office. Further information concerning this point is desired. Elliott in Arkansas reported the disease as "severe for the first time in my observations".

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc.

Cane blight was more generally reported than usual but was not regarded as important in most states. It was reported from Massachusetts (worse than last year and rather important), New York (serious in some plantings), New Jersey (common), Pennsylvania, Tennessee (reported to have killed thirty acres for a grower in middle Tennessee a few years ago), Arkansas (5% of crop injured), Ohio, Illinois (of questionable importance; can always be found on old canes in black cap patches and on wild black raspberries), Michigan, Minnesota, Idaho (fairly common), and Wisconsin (as usual).

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz.

Reported from Connecticut, Arkansas (first outbreak noted, quite severe, 10% of crop injured), Illinois (while the fungus is everywhere found on the canes of red raspberry no evidence of spur blight was ever noted), Wisconsin, Minnesota and Washington.

Other diseases.

Rust caused by Phragmidium imitans was reported from Washington (Frank) as quite prevalent on Cuthbert and Antwerp.

Powdery mildew caused by Sphaerotheca humuli (DC.) Burr. was reported as causing 2-3% loss locally in Ohio, and from Minnesota where it was regarded as unimportant.

Blue stem, cause unknown, was reported from Ohio.

Dodder caused by Cuscuta sp. was reported from Danbury, Connecticut by Clinton.

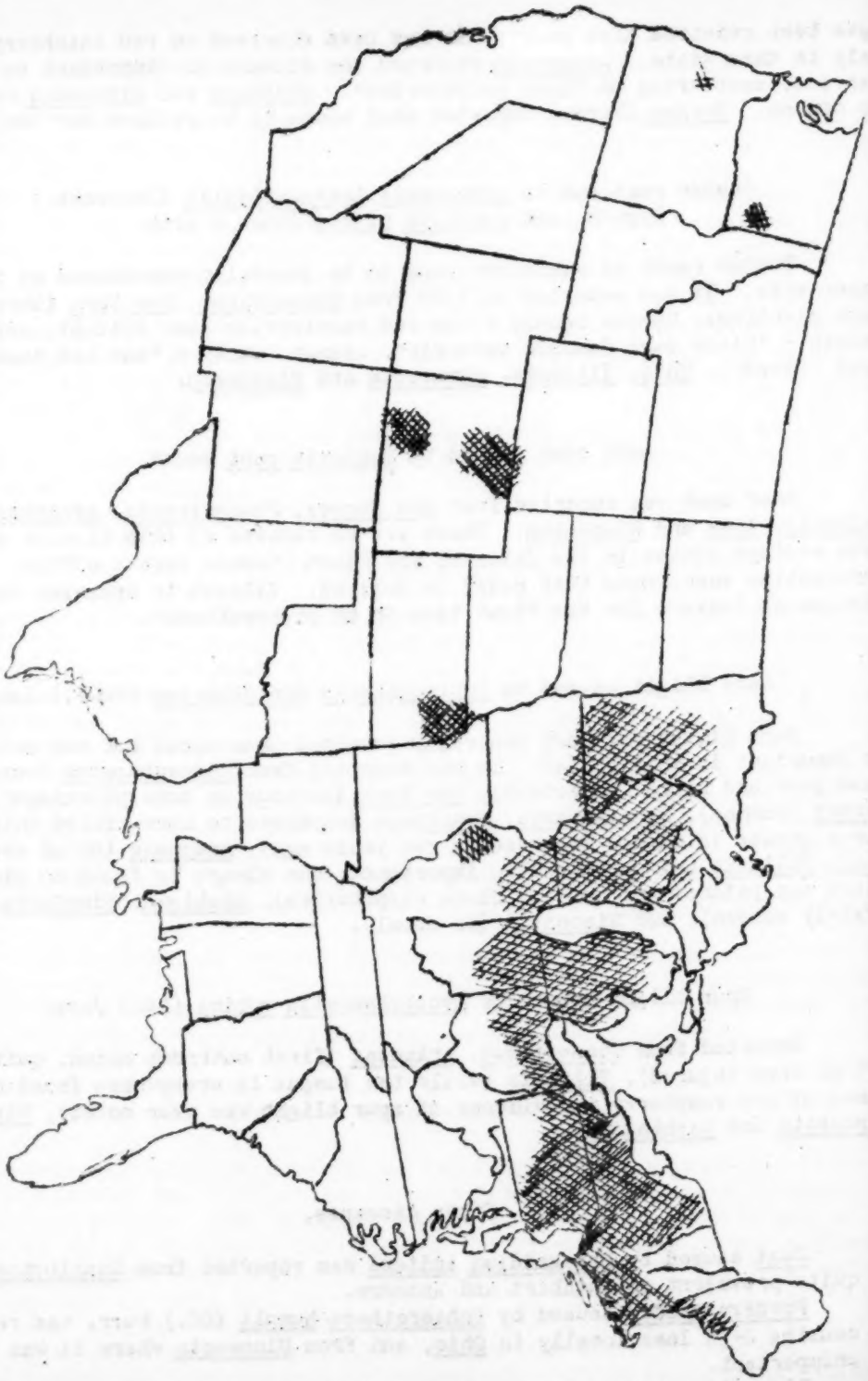

Fig. 15. Distribution of raspberry yellows as shown by records of the Plant Disease Survey.

Winter injury. Illinois (Anderson) reported the dying back of the canes of red raspberries throughout the central and northern portions of the state. While there is always some tip injury, the canes were often killed back half their length. The cause of the injury was difficult to explain since the winter of 1919-20 was not unusually severe. Winter injury was also reported from Connecticut and Washington. In Washington a frost killed the young shoots and spurs and these were later invaded by bacteria, according to Heald and Dana.

Gray mold rot caused by Botrytis sp. was found by inspectors of the Bureau of Markets, on raspberries in seven cars from Michigan, the decay ranging from 4 to 15% with an average of 9%.

Rhizopus rot caused by Rhizopus sp. was noted on raspberries in three cars from Michigan averaging 9%. This decay affected about 30% of the raspberries in one car from Michigan.

BLACKBERRY, DEWBERRY and LOGANBERRY

Orange rust caused by Gymnosconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens (Schw.) Arth.

About the usual amount of orange rust was reported during 1920 on the above hosts. As a rule most of the damage was reported on wild blackberries and dewberries. The following states reported the disease in 1920: Connecticut, New York (not important, earliest appearance May 24), New Jersey (sometimes destructive), Pennsylvania (reported as destructive in Jefferson County. First observed June 1), West Virginia (abundant and destructive to the wild high blackberries. The short cycle rust is the common one in this locality. Also reported as common on wild dewberries - Sheldon). District of Columbia (observed on young dewberry plants as early as May 12; season late - Haskell), Georgia (common, all blackberries attacked but dewberries resistant - McClintock), Arkansas (general, 2% injury), Tennessee (widespread; 3 samples gave both Kunkelia and Gymnoconia, one sample gave the latter only - Hesler), Ohio (more than usual), Indiana (less than last year), Illinois (common only on wild blackberries and dewberries. Snyder quite resistant, LaGrange very susceptible), Iowa (5% loss), Wisconsin and Minnesota.

Anthracnose caused by Plectodiscella veneta Burkholder.

This disease is considered of little importance on the blackberry and dewberry although very serious on raspberry. It was reported in 1920 from New Jersey, Ohio, Indiana (worse), Illinois, Iowa, Minnesota and Washington (especially on Snyder). It was not reported on dewberry. It was found on loganberry in Washington and Oregon.

Leaf spot caused by Septoria rubi Westd.

It is probable that this disease is more common on blackberry than on raspberry but is of so little importance that it is not thought worth while to report it. For this reason, no doubt, only five states, New Jersey, Texas, Ohio, Minnesota and Iowa sent in reports. Washington reported the disease on loganberry. It was reported on wild dewberry from West Virginia.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. is considered the limiting factor in the growing of blackberries in Wisconsin. In one planting 10% of the plants were killed. Also reported from Ohio, Illinois (important), Texas, Michigan, Minnesota, Washington and Oregon. This disease is also reported on loganberry from Washington.

Mushroom root rot caused by Armillaria mellea Vahl. was reported from Washington.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc. was reported on blackberry from Ohio and Washington.

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz. was reported from Washington on loganberry and from Minnesota on blackberry.

Double blossom caused by Fusarium rubi Wint. was reported on dewberry from New Jersey.

A crown rot, cause unknown, was reported by Barss from Oregon on loganberries. Severe in scattered plantings causing death of one-third of plants in a few instances.

Winter injury was reported as quite serious to blackberry and loganberry in Washington. In some cases there was a total loss of the blackberries and in the Puyallup district 5-25% injury was recorded by Heald and Dana. Evergreen was very severely affected. Injury to the loganberry was also very serious.

Gray mold rot caused by Botrytis sp. was found by inspectors of the Bureau of Markets on dewberries in 16 cars from North Carolina, the decay in 5 cars ranging from 25-45% and in 11 cars from 4-20%, with an average for all cars of 19%.

Rhizopus rot caused by Rhizopus sp. was present in 6 cars of dewberries shipped from North Carolina, the decay averaging 23%.

DISEASES OF SUB-TROPICAL FRUITS

CITRUS

Canker caused by Bacterium citri (Hasse) Jehle

The following summary of present and past conditions of the citrus canker in Florida shows that this disease is at present under complete control. An outbreak was discovered in July of the past year near Boynton (539 trees) but has been completely eradicated.

Citrus canker eradication work. Florida State Plant Board cooperating with the Bureau of Plant Industry for quarter ending December 30, 1920 (The Quarterly Bulletin Fla. St. Pl. Bd. 5: 127-128 1921.)

Citrus grove trees inspected	1,223,388
Citrus nursery trees inspected	15,641,064
Inspectors employed	89
Total properties showing active infection	0

Total properties showing infection.....	0
Grove trees found infected.....	0
Nursery trees found infected.....	0
Counties in which active infections were found.....	0

General summary of citrus canker eradication work in Florida since beginning of eradication campaign.

Florida counties in which canker has been found.....	22
Grove trees found infected since May, 1914.....	14,267
Nursery trees found infected since May, 1914.....	342,254
Number of properties infected to December 30, 1920..	486
Properties declared no longer "danger centers".....	479
Properties still classed as "infected" December 31, 1920.	7

Table 40. Number of grove trees found infected with canker, per month, since the work began in May of 1914.

1914	1915	1916	1917	1918	1919	1920
May 108	Jan. 306	Jan. 86	Jan. 14	Jan. 0	Jan. 0	Jan. 0
June 160	Feb. 165	Feb. 21	Feb. 4	Feb. 1	Feb. 0	Feb. 0
July 275	Mar. 444	Mar. 49	Mar. 9	Mar. 1	Mar. 1	Mar. 0
Aug. 1313	Apr. 408	Apr. 49	Apr. 169	Apr. 2	Apr. 1	Apr. 0
Sept. 767	May 1042	May 338	May 52	May 1	May 1	May 0
Oct. 565	June 772	June 450	June 45	June 10	June 0	June 0
Nov. 773	July 651	July 349	July 39	July 0	July 0	July 539
Dec. 366	Aug. 1345	Aug. 219	Aug. 30	Aug. 0	Aug. 1	Aug. 1
	Sept. 618	Sept. 124	Sept. 6	Sept. 0	Sept. 0	Sept. 0
	Oct. 214	Oct. 451	Oct. 2	Oct. 0	Oct. 0	Oct. 0
	Nov. 494	Nov. 131	Nov. 1	Nov. 0	Nov. 0	Nov. 0
	Dec. 256	Dec. 27	Dec. 1	Dec. 0	Dec. 0	Dec. 0
4327	6715	2294	372	15	4	540

Citrus canker also occurred in Texas in 1920, but at present this disease is under complete control throughout the entire South and only occasional local outbreaks may be expected in the future.

The following report on canker in the Philippines and elsewhere in the Orient was kindly furnished by H. Atherton Lee:

> "This disease is universally distributed throughout Japan, China, Formosa, the Philippines, and had been reported to me by Dr. Yates from Borneo and Dr. Hartley from Java. The literature, of course, reports the disease from Australia. It is not serious in Japan, China, Formosa, or in the Philippines inasmuch as the varieties grown are largely resistant species. Occasionally, in a dooryard tree, a susceptible variety will be partially defoliated and the fruit badly blemished."

Melanose caused by Phomopsis citri Fawcett.

This disease was reported by J. R. Winston, United States Department of Agriculture, on grapefruit and oranges in Florida as moderate on the former fruit and moderate to abundant on the latter. It was estimated that 10% of the grapefruit and 20% of the orange crop was injured. This, according to Winston, would amount to a loss of about $250,000 and $1,000,000 to grapefruit and oranges. The accompanying map shows the places where the disease was worst in 1920.

H. Atherton Lee reported as follows on Melanose:

> "I observed this disease caused by Phomopsis citri only in Japan upon the Unshiu varieties and Pummelo varieties. It is very serious in Japan, often causing defoliation. Japanese growers report that it is easily prevented by spraying. It was not observed by me in China, Formosa, or in the Philippines."

Fig. 16. Areas where melanose of orange was serious in Florida in 1920 according to J. R. Winston. The disease was also bad on grapefruit in these same areas.

Wither tip or anthracnose attributed to Colletotrichum gloeosporioides Penz.

Wither tip and anthracnose were reported from the east coast of Florida by J. R. Winston who estimated about $25,000 loss to grapefruit. According to him, copper sprays applied in the fall usually give negative results.

H. Atherton Lee reports having observed this disease on grapefruit and sweet orange trees in the Philippines, but never causing serious injury.

Fig. 17. Anthracnose of grapefruit, occurrence 1920 according to J. R. Winston.

Withertip of limes caused by Gloeosporium limetticolum Clausen

About the average amount of lime withertip occurred in Florida in 1920, according to J. R. Winston, who estimated about 30% of the trees injured. The disease occurs for the most part on the Key or Mexican varieties. This disease has been observed in the Philippines, Japan and China, by H. Atherton Lee, but as limes are not commercially important in those countries the disease is not serious.

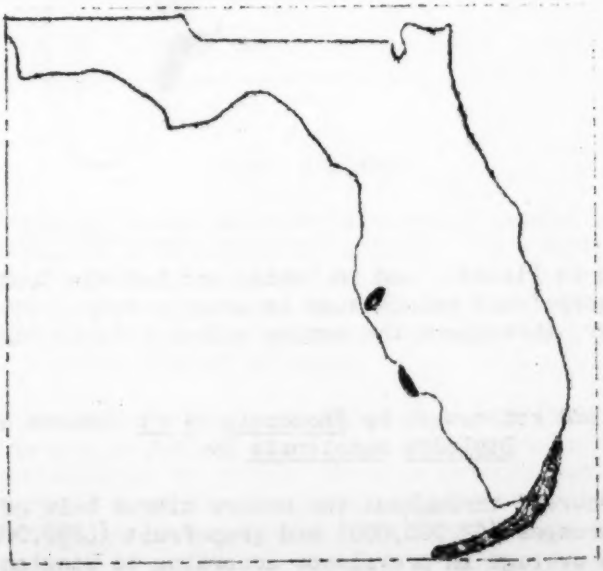

Fig. 18. Withertip of limes in Florida. Shades areas indicate regions where the disease was most severe in 1920 according to J. R. Winston

Citrus scab caused by Cladosporium citri Massee.

The information on scab in Alabama and Florida was supplied by H. R. Fulton and J. R. Winston.

In Florida scab was of moderate prevalence but it is annually becoming more widespread. In 1920 it probably injured nearly 20% of the crop of Florida grapefruit, resulting in a loss that may be placed at $500,000. When copper sprays were applied in the spring, thoroughly and at the right time, the results were excellent. Winston mentions the grapefruit variety Hall as very susceptible, the Royal and Triumph apparently immune, while other varieties are moderately susceptible.

In Alabama Fulton reported scab as more prevalent than during previous years on grapefruit and Satsuma oranges in Mobile and Baldwin Counties. Ten percent of the grapefruit, which are not very important commercially, were affected, and $50,000 loss to Satsumas was estimated. Copper sprays in the spring gave favorable results.

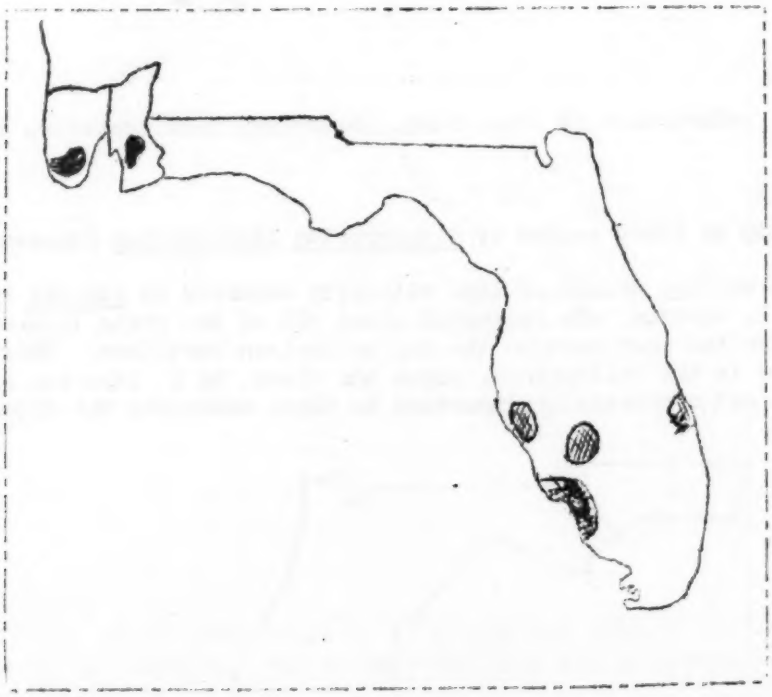

Fig. 19. Areas in Florida, and in Mobile and Baldwin Counties, Alabama, where citrus scab on grapefruit and Satsuma is usually very serious. The disease occurs, however, throughout the entire citrus belt of Florida.

Stem end rot caused by Phomopsis citri Fawcett and Diplodia natalensis Ev.

Stem end rot occurred throughout the entire citrus belt of Florida causing heavy losses to both oranges ($2,000,000) and grapefruit ($250,000). It was considerably above the average in prevalence according to Winston. No varieties seem to be resistant.

It was noted by inspectors of the Bureau of Markets on citrus in two cars from California, the decay ranging from 10-40%, and fruit in 51 cars from Florida showed decay ranging from 1-3%.

Blue mold rot caused by Penicillium sp.

Table 41. Losses from blue mold rot of citrus fruits caused by Penicillium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Oranges		Tangerines		Grapefruit		Lemons	
	No. cars with decay	Percent rot	No. cars with decay	Percent rot	No. cars with decay	Percent rot	No. cars with decay	Percent rot
Florida	2	50-55	44	1-19	1	54		
	27	25-40			9	25-36		
	457	1-24			341	1-24		
	486	Av. 9			351	Av. 13		
California	2	55-65			5	2-32	1	65
	23	25-45					8	25-45
	467	1-24					189	1-23
	494	Av. 7					198	Av. 13
							2	50-65
							16	2-15
							18	Av. 14
Unknown							1	10
Total & av.	980	Av. 8	44	10	356	Av. 10	211	Av. 13

Other diseases.

Foot rot of orange (cause undetermined) was reported by Winston from Florida as very prevalent in old seedling groves. The removal of affected parts seems to give results but it is usually not worth the cost of the operation. According to Winston sweet oranges are very susceptible, rough lemon and grapefruit are susceptible, and sour oranges are apparently immune. A foot rot was reported by H. Atherton Lee as follows:

> "This disease has been observed in the Philippines, in China and in Japan. Next to psorosis, it is probably the worst disease of citrus trees in oriental countries. I observed it most seriously on seedling trees of the sweet orange and trees budded upon sweet orange stock."

Ammoniated fruit-dieback (cause undetermined) occurred throughout the entire citrus belt of Florida in average amounts. Winston reports good results with application of copper sulphate to the soil.

Gummosis was reported by J. G. Brown, causing 1/4 to 1% loss in Arizona.

H. Atherton Lee, Mycologist of the Bureau of Science, Philippine Islands, has furnished the following data concerning a number of diseases of citrus fruits in the Orient and especially the Philippines:

Pink disease caused by Corticium salmonicolor:

"This disease has been observed by me in the Philippines and Formosa. I did not see it in China nor in Japan. It is very serious in the highly cultivated groves but is not found so commonly in the groves which are uncared for. In orchards where preventive measures are not practiced, this disease can be much more serious than psorosis. The control of the disease is very simple, however, and therefore need not be regarded as seriously as psorosis, foot rot, or bark rot. Pink disease is also serious on cacao, coffee, rubber, acacias and many other economic host plants."

Psorosis or California scaly bark:

"This disease has been observed in Ikiriki, Japan, upon what is known in that country as the 'dai dai', a form of Citrus aurantium. It was also observed in Guam upon a tree of the sweet orange, Citrus sinensis. There occurs on Luzon and throughout South China, a disease which resembles very much psorosis and I am of the opinion that it is the same. Psorosis therefore is universally distributed throughout the Orient and oriental tropical countries. The disease is very serious and is the principal limiting factor to citrus production in South China and the Philippines." (First report)

Florida scaly bark or nail head rust:

"This disease has been found in the Philippines upon trees of the sweet orange, Citrus sinensis, but does very little injury. I did not see it in China or Japan."

Dry rot:

"This disease has been found in the Philippines, China, Formosa, and Japan. We have shown by isolation and inoculation experiments that it is due to a fungus and a later report will appear. It causes the fruit to become dry on the inside similar to the drying of fruits described by Shamel in the Journal of Heredity. We examined some of Shamel's fruits, however, and did not find the organism and we regard his trouble as entirely different from ours although the results are the same in both cases. The dry rot is not visible externally but makes the fruit entirely worthless for eating. The disease in nature affects a large percentage of fruits and consequently is very serious especially in the Philippines." (First report)

Bark rot:

"This disease has been observed upon trees of the mandarin orange, Citrus nobilis. It is very serious in the Philippines, ranking next to psorosis and foot rot in importance. It is also found in China. This disease was also found in the southern part of Japan on trees of the Unshiu varieties, Citrus nobilis var. unshiu (Satsuma). It is quite serious in southern Japan affecting for the most part the older trees and frequently causing the death of the old trees. There is some possibility that this is the same disease described from South Africa as due to Diplodia natalensis, but I have not had opportunity to corroborate my opinion."

Mottled leaf:

"I have never observed this disease upon seedling trees in the Philippines, nor upon plants on Citrus nobilis stock in China, nor upon plants on Citrus trifoliata stock in Japan. Such stocks are the ones generally used for propagating in these countries. In the Philippines, however, it is very serious upon trees budded upon pummelo stock. It causes no extensive injury inasmuch as seedling trees are grown for the most part."

Greasy spot:

"This disease I observed very commonly in Japan, the Philippines and China. In Japan it was occasionally very serious, causing partial defoliation of the tree."

Brown rot of lemons caused by Pythiacystis citrophthora Sm. & Sm. was found by inspectors of the Bureau of Markets in lemons in two cars shipped from California, the decay ranging from 5-19%. Ten cars of Italian lemons showed decay from 2-12%.

Center rot of lemons caused by Alternaria sp. was present in 91 cars from California, the average decay about 10%. The lemons in six cars from Italy showed decay from 4-55% with a probable average of 18%.

BANANA

Wilt caused by Fusarium cubense EFS. The following report on this disease in the Philippines was furnished us by H. Atherton Lee:

"This disease was found in Laguna and Batangas provinces in June of this year. It had not been previously reported in any place in the Philippines. It is sporadic in occurrence and will affect one plantation and escape many nearby plantations of the same susceptible variety. Affected plantations are not numerous but are very seriously hit when once affected. The disease attacks, in our experience, only the Latundan variety which is the most popular variety in central Luzon. This is the only variety we have found susceptible."

Heart rot, cause unknown. H. Atherton Lee has furnished the following report on this disease as it occurs in the Philippines:

> "This disease is a rotting of the terminal bud which extends down through the central cylinder causing it to become black and having a disagreeable saline odor. This disease I have not seen described as yet from other countries. It is quite common but does not cause extensive injury. The pseudostem may be cut off below the limits of infection and new suckers arising are usually free from the disease. We have found it in practically all provinces of Luzon where bananas are grown."

Rhizopus rot caused by Rhizopus sp. was present on bananas in 40 cars of the 133 cars examined by the inspectors of the Bureau of Markets. From 2-5% decay was noted on bananas in four cars from Central America, about 2% in Mexican bananas in two cars, and about 1-37% in bananas in thirty-four cars of unknown origin.

PINEAPPLE

Rot caused by Thielaviopsis sp.:

> "This disease is very generally distributed where pineapples are grown in the Philippines. We have found Thielaviopsis on the fruits, leaves, and suckers. In the total, it produces an immense amount of loss which it is impossible to present in any definite estimate."
> --H. Atherton Lee.

Wilt, cause undetermined:

> "This disease we have found only in the province of Bataan, P. I., on a single plantation. The disease is found only on Hawaiian varieties, and native plantings are either resistant or have not been infected. We have made a very extensive field survey for this disease and find it in only this one locality. The evidence would indicate that the disease was of recent introduction and has not yet been distributed throughout the provinces. Upon the one plantation where the disease was found, the loss was fairly severe."
> --H. Atherton Lee.

FIG

Rust caused by Physopella fici (Cast.) Arth. (Uredo fici Cast.) was reported from Texas by Taubenhaus but was considered unimportant.

Anthracnose caused by Glomerella cingulata (Stoneman) Sp. & von S. was reported from Texas as an unimportant disease this season.

Canker caused by Macrophoma fici was reported from Texas.

DISEASES OF NUTS

PECAN

Scab caused by Fusicladium effusum Wint.

This disease was extremely serious in the Mississippi pecan groves according to Neal. It was more prevalent than last year and worse than usual. It is especially severe on the coast but is increasing in other parts of the state. The disease was first observed at Ocean Springs on May 20, and at that time was very abundant. Delmos, Schley, Van Deman and Pabst varieties were severely infected. The last named variety was supposed to be immune. A loss of 25% of the crop is estimated by Neal. The disease caused scabby nuts with premature falling.

Powdery mildew caused by Microsphaera alni (Wal.) Salm.

This disease was common in Mississippi in various parts of the state but the losses were negligible.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Mississippi (Centerville). The growers state that the disease originated in the nursery.

Blight caused by Phyllosticta caryae Pk. was reported from one county in Mississippi.

Die-back caused by various fungi, including Colletotrichum and Alternaria, was reported from Arizona.

Rosette, cause unknown, was observed in Mississippi but was not considered serious.

Black pit, cause unknown, was reported from Mississippi.

WALNUT and BUTTERNUT

Leaf spot caused by Marssonia juglandis (Lib.) P. Magnus was reported as causing a 5% loss in Iowa. It was also unusually serious on black walnut and butternut in Illinois and central Indiana. This is probably the most serious disease of these nuts, since it often causes an early defoliation.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported as heavily infecting walnuts in parts of California.

Bacterial blight of English walnut caused by Bacterium juglandis was reported by Barss as "common and troublesome throughout western Oregon. In some cases as high as 50-75% of crop rendered worthless, but the general damage may not have exceeded 25%. No immune sorts yet discovered and no control known."

Winter injury caused serious losses in Washington and Oregon to English walnuts. Most of the trees were killed back to a few branches, according to

Heald and Dana. In Oregon it was very serious to walnuts planted on low lands. See also special report of D. F. Fisher under apple winter injury, pages 54-56.

COCOANUT

Bud rot was reported from the Philippines by H. Atherton Lee as follows:

> "This disease is very widespread and there are numerous complaints of injury. Bud rot is reported from all the largest islands of the Philippines."

Red ring, a serious disease of cocoanut palms in the West Indies, has been recently discovered in the Canal Zone and is causing some concern on account of its known destructive character.

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